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SHADE.

The importance of studying the natural habitat of our cultivated products, more especially with regard to the protection from disease and insect attack they enjoy through the shelter of their forest companions, has scarcely we think been adequately realized in the planting world. Yet to succeed with the cultivation of a plant we should certainly try to reproduce as far as possible the environments with which it flourished in the wild state; and this involves the study of those environments. Most of the important products of the small tree or shrub type now cultivated in the tropics being of forest or semi-forest origin, we may take it that some degree of shade is necessary for their welfare. Coffee to which we referred in our August number is a case in point. In Abyssinia, the home of Arabian Coffee, it occurs, as MR. BRYCE pointed out in a note we published in the September issue, "in open, park-like country, amongst tall trees mostly evergreens, under whose shade the coffee bushes are most numerous." We now know that coffee under light shade enjoys a greater degree of immunity from leaf disease than that under no shade at all. MR. BRYCE states that in Abyssinia October to March is the dry season, so that we might expect that Arabian coffee thrives best in a country with a fairly long dry season during which it can shed its leaves, an expectation that also corresponds with present-day experience.

The circumstances with regard to Tea are in some respects similar. WATTS states,* "In 1882 the wild tea plant was found by

* The Commercial Products of India.

me as a forest tree or large bush in the eastern tracts of Manipur." We take the bushes from their forest seclusion, expose them all crowded together under the full glare of daylight to discover that they become the prey of all manner of vermin. MR. GREEN, the late Government Entomologist, Ceylon, was of opinion that dadaps, albizzia and perhaps other trees grown among tea for green manure acted as a deterrent to the attack of Tea Tortrix, and MR. J. R. NEALE of Bogawantalawa in a letter to the writer on this subject said, "my experience goes to show that open areas devoid of shade are most liable to attack." Other planters hold the same view and it is one that, bearing in mind the conditions of the natural habitat of tea, we should expect to find correct.

But if shade may be regarded as an important factor in the successful cultivation of many of our products, especially when bushes or small trees, it should be carefully regulated so that while affording the required protection it may not obstruct light and air and check the crops. To illustrate this point we may take the case of cocoa, also of forest origin (basins of the Amazon and Orinoco) and which in Ceylon can sometimes be observed almost overwhelmed with shade trees. Cocoa belongs to that category of products in which we depend for crop upon a good flowering, and flowering is promoted by light and air. Some cocoa manuring experiments were begun at Peradeniya in 1906. Liberal dressings of manure were applied annually (except to controls) till 1912 when manuring was stopped to watch the effect of the unexhausted residue.

The crop from all the plots averaged for these 7 years 4·7 cwt. per acre. In 1914-15, after three years of no manuring the crop averaged 6·1 cwt. per acre. But in the interval the shade trees which had grown very large were pruned back. The late DR. LOCK had drawn attention* to the remarkable results at Peradeniya following pruning. In 1907-8 the yield from 8 acres of unmanured cocoa yielded at the rate of 5·8 cwt. per acre. The group suffered from an excess of shade, having between 300 to 400 shade trees per acre, but in 1907 these were cut out to one-tenth. The next year, 1908-9, the crop jumped

* Circular of the R. B. G. Vol. XI., No. 9.

to 7·8 cwt. per acre. To show conclusively that this improvement was due to reduction of shade DR. LOCK tabulated the yields from an adjacent field of 42 acres in which the shade had not been cut out. For the same years the yields were 3·2 cwt. and 2·5 cwt.; i.e., instead of a rise of 2 cwt. per acre, a drop of 1·7 cwt.

These products, typical of several others—Vanilla and Nutmegs for example—demand the nicest adjustment of shade for their welfare, each too in a separate degree; but there are some that delight to be drenched in sunlight, provided their moisture requirements are met, and to which shade is inimical. Such are lofty trees like Para rubber designed by nature for protecting small companions of the forest, not to be themselves shaded.

R. N. L.

"KAOLIANG," A NEW DRY-LAND SORGHUM.

A. N. HUME AND M. CHAMPLIN.

Kaoliang was introduced from Manchuria (where it is grown as a forage and grain crop) by the United States Department of Agriculture to fill the demand for an early-ripening grain-sorghum in the Northern Great Plains.

It was first placed on trial at the South Dakota Experiment Station in 1909 and found to be extremely variable. Selection of the heaviest and most compact heads on stalks of uniform height was made during two seasons and in 1911 selected seed was distributed to a few farmers. Distribution of seed and selection have been continued during subsequent years until at the present time the crop is grown on some thousand farms in central and western South Dakota.

It has been found to be drought-resistant and has produced satisfactory yields in the driest seasons and better yields than maize. The crop has a comparatively low moisture requirement and should be planted towards the end of May on well prepared land and kept free from weeds.

Both seeds and stalks should be utilised for forage, so that the crop does not require threshing.—BULLETIN, INTERNATIONAL INST. OF AGRIC.

COCONUTS.

A NOTE ON COCONUT CULTIVATION IN THE SOUTHERN PROVINCE.

H. AMARASURIYA.

The Galle district of the Southern Province has the unique distinction of having been the first home of the coconut palm since its naturalization in this Island. According to tradition, the coconut was introduced into Ceylon by one of its own Kings and planted in Weligama whence its cultivation spread to other parts of the Island.

A striking feature of the Southern Province is its extensive sea frontage beginning at Bentota on the South-west and running up to the limit of the Hambantota district on the South-east—a distance of roughly 150 miles; but along this maritime area the coconut does not flourish much beyond Tangalla, up to which point it helps to make up the "palm-fringed beach" which strikes the eye of the traveller as he approaches our shores.

I would classify the coconut land of the Province under three heads and deal with it accordingly.

(1) *The sea-board area.*—This is the most important of the three and constitutes a continuous belt or palm grove from Bentota to Tangalla. It extends inland to a distance of from 8 to 10 miles. The nature of the cultivation along this area is familiar to most travellers on the southern coast line. Notwithstanding the efforts of this Society to bring home to the masses through its officers and its widely circulating publications, both in English and Sinhalese, the advantages of good cultivation, the rule among coconut landowners is to leave the palms to grow as best they can, with little or no tillage, weeding or manuring and, after taking in one crop, wait for the next. As a result, only half crops are secured, and cultivators, through their own apathy, are losing many thousands of rupees which they would otherwise earn by enterprise and energy.

What is most noticeable in the smaller gardens along this area is the close planting (in many cases as close as 15 or 18 ft.) and the non-observance of the fact that the coconut palm needs a free supply of sun and air if it is to grow and bear well. In better-cared for estates the common rate of planting is 70 trees to the acre. Under such conditions, in favourable situations, the palm takes about 10 years to come into bearing, though rare instances have occurred where under good management it flowers at 5 and bears nuts at 6.

A well-cultivated estate should yield at the rate of 60 nuts per tree per annum. This has been my own experience.

It is usual to make 6 pluckings in the year, but owing to the demands of the coir yarn industry, which flourishes along the southern coast, 7 pluckings are often made with the object of securing the husks for fibre. As a result the copra is not of the best quality, owing to its being made from nuts which are not fully mature, and fetches Rs. 15 or Rs. 20 less per candy than copra made from well-matured nuts.

(2) *The riverain area* includes the land found along the banks of the principal rivers, e.g., the Ginganga and Nilwalaganga. The growth in these zones is, as might be expected, very good except where trees suffer as they sometimes do from water-logging. The alluvial deposits during floods contribute materially to the fertility of such lands. The coconut belts along rivers do not, however, extend much beyond ¼ mile on either bank. An important advantage which cultivators in this area enjoy is the low cost of transport which is done by water.

(3) *The village garden area* is made up of little patches of coconuts round dwelling houses. To the villager the coconut is almost an indispensable article of food, and even in the remotest hamlets will be seen the results of his efforts to establish a few palms on which he can rely for his nuts. Sometimes it is only a single tree, but valued beyond any other garden product and jealously guarded. Such coconut palms, in near proximity to dwellings, are naturally well-nourished owing to the fact that they are amply supplied with fertilising agents drawn from the waste of the household. I have known such trees to bear as many as 140 nuts in the year, and their prolific nature has no doubt given rise to the saying that the coconut palm flourishes best within sound of the human voice. The difficulty is to induce the villager to extend his plantations, especially as the hilly nature of the interior deters him, the common belief being that the palm does not thrive, or requires special cultivation, when grown on hill sides. The fact is that the villager in general is too apathetic and too well provided-for by Nature to make any effort beyond that required to keep him supplied with the necessaries of life ; though in the vicinity of more populated centres he is becoming imbued with the spirit of enterprise and is acquiring a taste for what are more or less luxuries. At the same time it may be mentioned that extension of cultivation beyond the sea-board is not being carried on even by capitalists and that these areas are being given to tea and rubber by preference. The village garden area while sufficient to meet the requirements of rural life is practically of no account from a commercial point of view.

Once beyond Tangalla the general conditions for coconut cultivation become less favourable and the cultivation of paddy and dry land cereals comes more into evidence. There is no doubt, however, that as the Province becomes more thickly populated and the naturally-favoured areas for coconuts are exhausted, the capitalist will be forced to take up land in the drier parts (as is already being done in the neighbourhood of Puttalam, Wariyapola and Wellawa) and that cultivation will assume the nature of dry-farming.

In conclusion I should wish to submit, for the information of members, a record of the results of my own cultivation, in the hope that it will induce others to reap the benefits of manuring which, when judicially carried on, is most profitable. The results refer to a block of 16 acres of a fairly hilly nature, such as is not generally considered the most suitable for coconuts. It is a part of my "Citrus Group," Akmeemana, about 6 miles out of Galle, and I shall be only too pleased to show it to any members present to-day who have the time to pay the estate a visit. The manure mixture selected

by me as most suitable for local conditions was the following:—

Castor cake	... ...	14 parts
Crushed fish	... .	33 ,,
Steamed bones	... ...	14 ,,
Bone meal	... ...	14 ,,
Basic slag	... ...	6 ,,
Sulphate of Potash	... ...	13 ,,
Kainit ...	... ...	6 ,,
		100

15 lb. of this mixture was applied per tree, at a cost of 80 cents. This was applied twice every three years between 1910 and 1914 and gave the following results:—

	1910.	1911.	1912.	1913.	1914.
January ...	4,018	4,361	4,760	4,166	7,489
March ...	6,581	8,962	9,771	7,768	11,746
May ..	9,292	14,107	12,111	13,812	17,401
July ...	10,980	15,391	15,312	15,017	17,452
September ...	7,624	9,348	5,827	10,923	15,155
November ...	4,893	4,158	3,047	7,368	5,304
	43,388	56,327	50,828	59,254	74,547

H. AMARASURIYA.

Citrus Group, Akmeemana, 8th November, 1915.

MR. W. DE COURCY BROWNE of Kindar Estate, Solomon Islands, has sent us a very interesting photograph of a four months coconut seedling in bearing.

Such freaks occur occasionally and are to be seen at local agricultural shows.

CHEMICAL CHANGES IN THE RIPENING COCONUT.

TOMAS VISTA Y ISLES.

INTRODUCTION.

The changes occurring in the ripening coconut have been studied by GONZALES.* However, the value of his work is somewhat diminished because he did not know the exact ages of the nuts he analyzed, but was compelled to use size, colour, and thickness of the meat to indicate the relative ages of the nuts, an assumption which is subject to many errors. For this reason it seemed well to continue his work, especially since the number of nuts he

* PHIL. AGRICULTURIST AND FORESTER VOL. III. 2, 1914.

examined was rather small. In the present work the ages of the nuts analysed are expressed in days, counting from the day each spathe or flower-cluster opened.

The procedures used in all determinations were official methods, unless otherwise stated.

The percentages of husk, shell, and milk, in terms of the whole nut, were taken from their actual weights, while the percentage of meat (to avoid loss by evaporation) is assumed to be the percentage calculated on the difference between the weight of the whole nut and the sum of the weights of husk, shell, and milk.

CHANGES IN COLOUR, SIZE, AND WEIGHT.

When the spathe opens a cluster of pistillate and staminate flowers having a yellowish colour is exposed to the sun. About the third or fifth week the female flowers become fertilized. It is interesting to note that self-pollination is hardly possible, because before the stigmas become receptive all staminate flowers have been shed. After the pistillate flowers are pollinated the fertilized ovaries begin to increase in size. From this time on we can divide the changes taking place during the ripening of the coconut into four groups, namely:

1st. changes in colour.
2nd. changes in size.
3rd. changes in weight.
4th. changes in chemical composition.

The yellowish colour of the embryonic fruits, on exposure to the sun, is gradually changed to green, and finally to brown, when the nuts have become nearly ripe.

In the case of the yellow and red varieties the change in colour is from yellowish to yellow and red respectively, until such time as the colour in both varieties is changed to brown. As the colour changes are well marked, they are a fairly efficient guide in determining the degree of ripeness of the nuts.

The young nut at first increases most rapidly in size longitudinally (measured from the base to the tip of the fruit) until the meat begins to form and afterwards transversely.

On this account the ratio of the longitudinal diameter to the transverse diameter tends to decrease as the nut grows older, though it does not always happen that the oldest nuts have a greater longitudinal than transverse diameter. These variations in form continue until the nut is ripe. They are most striking when the measurements of the shell are taken, as the variation in shape of the husk is not so noticeable. Table I (omitted) shows the size of nuts of different ages, arranged in order of increasing age.

Parallel with the increase in size is the increase in weight. The nuts gain both moisture and dry matter at first, but during the later stages of ripening the loss due to evaporation of water more than counterbalances the gain due to increase of dry matter, and the nuts actually lose in weight. Because this loss of moisture takes place very largely from the husk, there is even a shrinkage of the latter, so that measurements of the external diameter of nuts in the husk show that a decrease of size accompanies the decrease of weight during the final stage of ripening.

In the case of mature nuts, though they contain the maximum amount of dry matter in the form of meat, shell, and husk, they are far lighter than those somewhat younger, because a large part of the water content of the husks has evaporated. Table II (not reproduced) shows the changes in weight of nuts at different ages.

It appears that the percentage of shell increases up to the very last, though the actual weights of shells from nuts of different ages do not show any such tendency, the increased percentage being due to the decrease of the total weight of the nut during the later stages of ripening. The percentage of husk decreases rapidly from the very first and if actual weights are considered it will be found that the weight of husks of fully mature nuts is from one-fifth to one-tenth of that of those that are about half mature. The percentage of water existing as liquid inside the nut is subject to great variations in individual nuts, but there is a decided tendency for the actual weight of water to decrease during the later stages of ripening. The total percentage of meat increases up to the very last, though this apparent gain during the last 100 days is due as much to the decrease of the total weight of the nut as to any other cause. The great variation in the weight of the endosperm of fully mature nuts is not altogether due to their difference in size, but rather to the fact that the meat of some nuts is decidedly thicker than that of others. This fact should be taken into consideration in the selection of seed-nuts by copra growers.

Another way which may be used in determining the degree of maturity of fruits, besides changes in colour and size, is by means of specific gravity. Young nuts are not only often far heavier than the old ones, but have higher specific gravities than the latter.

CHEMICAL CHANGES IN THE MILK.

The milk or liquid portion of unripe nuts is turbid, containing in semi-solution substances which can easily be precipitated by lead sub-acetate. The milk of the ripe nuts is also turbid, and when germination takes place oil may be seen floating in it.

The milk of coconuts, young or old, has an acid reaction. This is partly due to carbon dioxide dissolved in it, but mainly to organic acids, as may be shown by the fact that the juice when titrated with a standard alkali gives almost as great a figure, using methyl orange as an indicator, as it does with phenolphthalein. The acidity increases as the nut matures, and is greatest during the formation of the meat, then decreases, though there is towards maturity an irregular fluctuation. The amount of amino acids decreases, while the nitrogen content of the milk increases as the nut matures. Table III (not reproduced) shows these changes in the milk at different ages.

The procedure used in determining amino acids in the milk is to treat 100 cc. of the milk with 10 cc. of neutral formaldehyde. The acid set free is titrated with standard alkali free from carbon dioxide, using phenolphthalein as an indicator. From the number of cc. of standard alkali used in titration, the number of grams of amino acid, expressed as glycocoll, is calculated.

The milk of the young nut has lower specific gravity than that in which meat is being formed, and towards maturity irregular fluctuations occur, in which there is a general tendency to decrease. The specific gravity of the milk of nuts which have already sprouted is higher than that of the milk of mature ones that have not sprouted.

The percentage of milk gradually rises until the meat is formed, then decreases with further development of the latter, though irregular fluctuations occur here also.

Sucrose is absent in the milk of young nuts; the percentage of invert-sugar increases until the formation of meat begins. At this time sucrose is being formed, which increases with further development of the meat, but the percentage of invert sugar is always greater than that of sucrose.

In the case of the milk of sprouted nuts the percentage of sucrose increases, possibly, at the expense of the oil in the endosperm, which decreases at the same time. In Table IV (omitted) the changes in specific gravity, percentages of milk, invert sugar, and sucrose are well illustrated.

CHEMICAL CHANGES IN THE MEAT OR SOLID ENDOSPERM.

The very young nut contains no meat. When meat is formed it first appears as a thin coating of white watery substance. At first it does not occupy the whole inner surface of the shell, but only one end, that which is opposite the eye. As the meat gradually increases in thickness during further development it occupies more and more space until the whole inner surface of the shell is covered with it. Concurrent with this is the gradual hardening of the meat, beginning from the thickest part, and proceeding towards the thin part, which is near the eye.

Since the thickness of the meat at the two ends is not the same, even in mature nuts, measurements of the thickness of meat were taken at points between these two extremes.

The newly formed meat contains no sucrose, but only invert sugar; the latter is gradually produced, in increasing amounts, in the further development of the meat, and as the nut ripens the amount of invert sugar decreases. Mature or ripe nuts have therefore nearly equal amounts of sucrose and invert sugar. But when sprouting begins the percentage of both sugars is increased.

In the case of pine-apples large amounts of sugars* are accumulated during the ripening of the fruit, while with dates an accumulation of sugar† take place shortly before ripening.

As the nuts ripen the meat loses water. The percentage of dry matter in the meat is increased until the endosperm is well developed.

At the beginning of the formation of meat oil is absent, but as the nut ripens it appears and continues to accumulate. Parallel with this is an increase in the ash content of the meat.

The oil content of sprouted nut decreases. It is perhaps changed into sugars, for the meat of sprouted nuts contains much sugar. The ash content of the endosperm also decreases as the seedling becomes older.

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* KELLEY; Hawaii Expt. Sta., Bull. 28, 16-17.

† VINSON; Arizona Expt. Sta., Bull. 66, 405.

SUMMARY.

The conclusions drawn by GONZALES * were:

"During the first period there is an accumulation of invert sugar and animo acids in the milk or watery portion. The meat is still absent, the shell and husk are soft and watery, and the nut as a whole has its greatest diameter along the main axis.

"During the second period of growth sucrose appears in the milk and the specific gravity of the latter is high. During all this time water is lost from the coconut, though its total weight continues to increase. The nut has in the meantime been changing its shape, and begins to acquire its greatest diameter in a direction at right angles to the main axis.

"During the closing period of ripening there is a sudden rise in the content of oil in the endosperm. The specific gravity of the milk falls at the same time owing to the transfer of nutrient materials or to respiration. In the meantime the shell has become impervious, and the drying out of the husk results in a loss of weight, which overbalances the gain in weight due to other changes."

The present work has confirmed the above statements, except that it appears that mature nuts do not always have their greatest diameter in a direction at right angles to the main axis.

In addition to the conclusions cited above the following are deduced from the preceding data:

1. The meat begins to form when the nut is about six months old.

2. Only invert sugar is present in the meat when it is 0·1 cm. thick.

3. The general tendency of the nitrogen content of the meat is to rise.

4. As the nut becomes older the evaporation of the water from the husk causes an apparent increase in the percentages of meat, shell, and water but if the actual weights are considered it will be found that the weight of the shell undergoes little change during the later stages of ripening, while the weight of water appears to be subject to irregular fluctuations tending towards a decrease. The actual weight of the meat does not appear to increase much if any during the last 100 days, though analysis during this time shows that the endosperm changes greatly in composition. Most of the oil in fact is produced after the period when the nuts have become very decidedly brown.

5. When the nuts germinate the percentages of sucrose and invert sugar contained in the milk increase very rapidly. The percentages of these two sugars in the meat increase likewise. The nut that has just begun to sprout appears to make use of the nitrogenous constituent of the endosperm before much of the oil is removed, though the fact that but two nuts were analyzed will leave this statement somewhat in doubt.

6. In this locality it appears that nuts require in the neighbourhood of 370-410 days to become fully ripe, counting from the moment the spathes open.

The writer wishes to express his thanks to PROF. DEMING for suggestions and help during the progress of this work, and to DEAN COPELAND for valuable information.—THE PHILIPPINE AGRICULTURIST AND FORESTER.

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* PHIL. AGRICULTURIST AND FORESTER, VOL. III, 2 (1914) 31.

RUBBER.

PLANTING HEVEA ON THE AMAZON.

The following paragraphs are taken from a letter, which recently appeared in a paper published in Manaos, written by the owner of an estate near the mouth of the Purus River, some miles above Manaos, who is planting rubber extensively and apparently with a good deal of enthusiasm.

"On reading the message of the Governor of the State, in that interesting part where he treats of the means of encouraging the planting of *Hevea* in our State, I could not resist the duty of associating myself with this excellent train of thought, seeing that in my opinion the planting of *Hevea* is one of the surest means of assuring the future prosperity of the Amazon. I have, in fact, already planted many thousand rubber trees and am still continuing to do so.

"In addition to the recommendations of the Governor's message it would be specially useful, MR. EDITOR, if the authorities of the interior were instructed to insist upon *Hevea* being planted when State lands are encroached on and cleared for planting cassava. These clearances are abandoned after making the floor, and fresh forest is cleared for the ensuing year, leaving the former clearing to become overgrown again with jungle, while it would be so simple to plant *Hevea*, seeing that one man can plant a thousand trees in a day.

"It is thus that our forests are getting cut down without any permanent advantage to ourselves, and to the detriment of our children.

"If a man puts in a day's work planting a thousand rubber trees among his cassava, it is by no means a day lost, as cleaning out the weeds and undergrowth benefits the cassava as well, and when the cassava is pulled up at the end of the year, the land remains fairly clean for another six months, which gives the *Hevea* a start of eighteen months and a growth of ten feet in height so that it runs no risk of getting caught up and choked by the jungle afterwards.

"By adopting this plan I myself have rubber trees five years and eight months old, with a circumference of 110 centimeters at the base, that could already be tapped by modern methods."—INDIA RUBBER WORLD.

THE RUBBER SITUATION ON THE AMAZON.

MIGUEL P. SHELLEY.

The present low price of rubber, as we have predicted, has not affected the industry on the Amazon very much. The Amazon will always be able to compete with Ceylon in prices, as we have already said. The Amazon will not be removed as a producer of rubber. As cheap as they may be able to produce their rubber, the Amazon will be able to produce it still cheaper. The middlemen, however, who are many, between producer and consumer will

earn less profit. The proof of this is that during 1914 and 1915 there were very few failures recorded on the Amazon, and these in small amounts.

Practically the whole business is now connected on a cash basis. The war has cut off their former supplies from England, Germany and the other belligerent countries with which they had a 3-to-6 months' credit. Since the Amazon is compelled to import the necessaries of life, it is obliged to purchase goods from the United States. The commission houses and the manufacturers, although very anxious to get Amazonian trade (the National City Bank not yet having established an institution which could be of great help to them in ascertaining the credits), are exporting goods to them for cash only. The Amazonian importers buying for cash have no other course than to supply the *aviadores* for cash, who in their turn send goods to the rubber centres in the interior only upon the receipt of the rubber for the goods bought. In many instances a clerk of the *aviadore* goes along with the boat carrying the goods, to exchange them for rubber and other products.

The war of course has been very bad for all business and also for the Amazon, but at the same time it has taught the Amazon a good lesson. On account of the great risk it has removed the entire credit system by means of which they could overcharge 50 to 80 per cent. on the goods.

Everybody was squandering money in going to Europe and buying all kinds of useless paraphernalia. Some bought boats at $100,000, which, after being used once or twice a year, would remain idle the rest of the time. Now they are working on a real business basis. The rubber producer is taking from the *aviadore* only those goods which he must take and which he cannot raise on his estate. Formerly he was supplied with beans, rice, corn, canned stuff, etc., in order to make profit. These he could easily raise on his estate by farming, raising cattle, chickens, etc. Now he is actually doing these very things.

For these reasons it is our opinion that the Amazon, barring all other obstacles including the 22 per cent. duty to the government, can still compete with the East. There is no doubt that Para rubber is much better than Ceylon rubber for the manufacturer. Ceylon claims, however, that she supplies a rubber that is 25 per cent. richer than Para rubber because of the loss in washing. This will easily be overcome. It is already realized and all steps are being taken to cure the rubber in such a way as to obviate this loss and yield the same purity of rubber as Ceylon claims to produce.

The speculation in rubber on the Amazon is altogether shameful. In many instances the price here in New York is much lower than that paid by some export houses in Para. According to the present outlook sales at that port will be largely for future delivery. Though they do not have the rubber nor even have it in view, some Para exporters sell for future delivery at much lower price than is actually quoted in the New York market. Of course, should the quotation rise, they are liable to be badly caught. They do not take this into consideration, but continue to lower the price with every sale.

As we have stated above, the commerce is becoming more and more stable, since earning less they spend less. The government which calculates its budget from the former price or the prevailing price has a greater deficit each year and is seeking a way to regulate this, from which originate the valorization schemes. In attempting to improve this situation the State gets

in touch with the Federal Government, which, being already interested in other products, mixes them all up together, and brings forth a valorization plan which, while suitable to some, cannot be suitable to all. At any rate the entire thing will bring confusion and the men who will suffer will be the same rubber exporters.

The low price of rubber renders the income of the country less. For this reason they are trying to increase it by paying more attention to other products, especially hardwoods with which the forests of the Amazon are full, and which are very valuable and cannot be gotten in any other country. All other timber is also to be found there, and will surely be in demand after the war ceases.—INDIA RUBBER WORLD.

COST OF PRODUCTION OF PLANTATION RUBBER.

The Far Eastern press has of late devoted considerable attention to the question of giving greater publicity to estate costs. Opinions on the subject, of course, differ, the majority of the parties interested being opposed to the publication of costs, while a strong minority favour the publication of this information. The majority consider the cost of production of rubber as a business secret that should not be divulged, but the minority contend that rubber planting is an exceptional line of business and that it stands on a plane by itself. A correspondent of the Kuala Lumpur daily, MALAY MAIL, gives the following view of the question:—

Rubber planting is an industry practically limited to the Dutch East Indies, Malaya and Ceylon. There are rubber plantations in East Africa and in a few other parts of the globe, but their combined output is so small that their existence does not affect the question. Large sums of money have been secured from thousands of shareholders and invested in rubber plantations. The Far Eastern plantation industry has led to a change in Government policies. It concerns not only investors but the world in general, occupying a unique position not to be compared with general industries.

Though admitting this, there are many people who still maintain that it would not be a good thing to publish "all-in" costs. "Why," they ask, "should the whole world know our costs in producing rubber?" The MALAY MAIL'S correspondent believes that the adoption by all of the practice of publishing costs would lead to a greater economic stability—that the competitive element has to exist to produce the best results and that the competitive test can be safely applied to rubber estate work. The industry is, comparatively speaking, a young industry, with much to learn. The boom days are over, and prices are lowering to a more natural level. The successful estate manager is reducing his costs to a minimum by improved methods in tapping and by improvement in the yields obtained. If every estate published its costs, this economy should act as an incentive to those still producing on a fairly high scale.

Another point is that the vast number of shareholders who have invested in rubber naturally want to know not only what the output has been and what profit has been made, but what was the cost of production. But there

should be uniformity of accounts. It is difficult accurately to apportion estate charges. The average estate is planted in sections, and the rubber is in varying stages of development. If the whole estate is to bear the "all-in" costs, it is obvious that the sections of it that are not in bearing are going to consume a large amount of money without giving any output return. The accounts should be made separately for each section, so that it could be ascertained what the actual cost of working each section is. But where the whole estate is in bearing, and all estate and managerial items are chargeable against the rubber harvested, there is no reason why the cost per pound of rubber could not be published with beneficial results.—India Rubber World.

EXPERIMENTS ON THE TAPPING OF *HEVEA BRASILIENSIS.*

A. W. K. DE JONG.

Experiments on tapping to different depths showed that ordinary tapping gave a yield equal to 52 per cent., and deeper tapping 80 per cent. of that obtained on tapping right down to the wood. The width of the strip of bark removed, however, has no influence on the yield.

The direction of tapping (from above downwards or vice versa) did not give different results.

The rapid flow of latex obtained by means of repeated tapping would tend to prove that the stoppage of the flow should not be attributed to a lack of latex, but to the closing of the latex tubes. Experiments made with trees tapped throughout their circumference showed that after a time the latex produced could not be coagulated by acetic acid, thus giving additional proof that the cause of the stoppage of the flow of latex is due to a closing of the latex tubes.

As the result of preliminary experiments it appears that the evaporation of the latex and the drying of the bark have only a slight influence or none at all on the yield of rubber if the tapping cuts are re-opened each day.

When the distance between the cuts is 20 inches, the lowest generally produces more caoutchouc than the highest; if they are still further apart this is not the case. Daily or alternate-day tapping of the same tree showed that in the latter case the cuts were not sufficiently deep, probably owing to the drying of the bark. The strip of bark removed does not appear to have any great influence on the yield of rubber. When it affects the flow of sap the yield from each cut is diminished; otherwise wounding results in a greater local formation of rubber.

Young bark yields more rubber than old bark. Experiments carried out on the same and different trees have shown once more that left hand tapping is preferable to right-hand tapping.

Little or no difference occurs between the yield from a single 'V' and a single cut to the left. Experiments with cuts at different angles to the vertical show that the cut with the steepest inclination removes the greatest quantity of bark, while the yield of rubber (when the experiments were carried out on different trees) varied very little. When the cuts were made on the same tree, a vertical cut gave about half the yield of a cut forming an angle of about 50° with the vertical.

Experiments on the height of tapping on the same trees showed that : (1) there is no advantage in making one or two cuts above rather than below a previous cut ; (2) two cuts starting from the middle of the tapping area give a better result than two cuts made in the ordinary way at a distance of 10 to 14 inches, but in view of the results reported in Teysmannia (1913—530, 745; 1914—139, 337, 447), it is not probable that this would be the case in actual practice. The experiments also show that the influence of a new cut on an old cut appears in less than an hour, if the two cuts are not too far apart vertically, and also if they are at the same height and only two inches apart. If, however, they are at the same height but far enough apart to be on opposite sides of the tree, no difference is observed even after one hour. This fact also shows that the transport of the latex along the latex vessels in *Hevea* occurs with great facility. With tapping twice a day, equilibrium was established four hours after the first cut, and did not change for the rest of the day.

In trees tapped by a cut right round the trunk, the latex from above the ring was found to contain tyrosin and its derivatives as well as tyrosinase, whilst the latex from below this ring contained only tyrosinase. It was found also that isolated pieces of bark may produce rubber.

The girths of *Hevea* trees at the respective height of 4, 34 and 53 inches are proportionally as 1·60 : 1·13 : 1.

Opening the same cut twice per day economises the bark and it is more advantageous to effect the second cut at 10 a.m. if the first cut was made at 6 a.m. Another cut on the opposite side of the tree has little influence on the yield of the first cut, and conversely the closing up of one of the opposite cuts has only a slight effect in increasing the yield from the other.—Bull. of the International Inst. of Agric.

PAPAW FRUITS TAPPED FOR PAPAIN.

To the Editor of the Tropical Agriculturist.

Dear Sir,

On pages 124 and 125 of the August Tropical Agriculturist, there are two statements which appear to contradict one another. (1) In the former Dr. Huybertsz states that the tapping of the fruit produces a spurious ripening which is characterised by an insipid flavour, and that such fruit is only fit for the poultry yard; (2) in the latter the report of the Hawaiian Experiment Station makes out that tapping improves the flavour of the fruit which is in no way injured by the process.

It may be that (1) refers to hard tapping and (2) to moderate tapping: but my own experience is that growing the papaw for fruit and for papain is not to be recommended and that scoring the fruit to any extent is calculated to spoil it. No fruit-grower will advocate the bruising of fruit in any way.

Yours truly,

C. D.

COCOA.

CONSUMPTION OF COCOA IN AMERICA.

The increase in the consumption of cacao in the United States is nothing short of phenomenal. In 1881-5 it was about 8,000,000 lb., in 1896-1900 it rose to 29,000,000 lb. In the next five years the quantity doubled, amounting to 58,000,000 lb.; in the next period it increased 63 per cent. and amounted to 95,000,000 lb; and in the last period it was 144,000,000 lb.

The value of the imports did not reach a million dollars until 1881-85. In 1901-05 it was $7,000,000, and in 1911-14 was more than double what it was in 1901-05. This increase in the value of the cacao imported has made it almost equal to that of tea.

The consumption did not reach 1 pound per capita until the 1906-10 period, and in the next period it increased 50 per cent., or to one and a half pounds per capita. "The price of cacao, which was only 3·3 cents per pound in 1851-55, increased until it was 14·73 cents in 1876-80. Since then, while the quantity has increased thirty times, the value has only fallen to 11·39 cents per pound.

The average consumption of cacao in the United States in the four years, 1911-14, was 2,000,000 pounds more than the total production of the world in 1894. Since that time the production of the world has increased over four times, being 609,000,000 pounds in 1914, while during the same period, the consumption in the United States has increased over seven times.

During the last twenty years the consumption of tea in the United States has increased 7 per cent; that of coffee 56 per cent; while that of cacao has increased 575 per cent. Unless there are new sources of supply of cacao it will not be possible for the United States to increase its consumption at the same rate during the next twenty years.—TEA AND COFFEE TRADE JOURNAL.

Reference is made in the SOUTH AFRICAN POULTRY JOURNAL for September to an egg produced in the run belonging to MR. CRAIK of Maritzburg. Its size round the middle was 7 inches and lengthwise it was 8¼ inches. In weight it was a few grains under a quarter of a pound. It was laid by a leghorn hen of medium weight. Age of fowl about 3 years. Is it the biggest and heaviest egg ever produced?

RICE.

IRRIGATING AND DRAINING THE RICE CROP IN CALIFORNIA.

The U. S. A. Department of Agriculture's Farmers' Bulletin No. 688 deals with Rice Cultivation in California, and refers to the irrigation and drainage of rice fields as follows:—

Because continuous submergence at a uniform depth is necessary for the growth of rice, only level land with a good slope for drainage should be selected for this crop. The field should be inclosed by strong embankments and so subdivided that each subfield shall have a surface level enough to hold the irrigation water at the required depth.

These conditions can be obtained by constructing field levees on contour lines at distances which, during submergence, will hold water at an average depth of 5 or 6 inches. These levees should be just high enough to prevent the water from overflowing into the subfields below and so broad that all kinds of machinery used in the cultivation of rice may pass over them easily without damaging them. Such levees will be low and very broad. They should be planted to rice. If this is done the cultivated area is increased and no uncultivated strips of land are left in the field for the growth of weeds. The growth of rice upon the field levees may not be equal in every respect to the main crop, but the results that will be obtained in the control of weeds alone will justify the practice.

The levees should be permanent and accurately located.

The successful growth of this crop often depends upon the availability of water at the time of planting. While it may not always be necessary to apply water for the germination of the seed, it is never safe in this section to seed the crop without having a good supply of available water.

If the water supply is to be developed from wells, the digging of the wells should precede the planting. Where this has not been done, heavy losses have resulted. The acreage to be watered from a well should never overtax the supply. Until more is known about the underground waters of these two valleys, wells should not be depended upon as the only source of water for rice, except in the artesian districts.

On typical adobe soil, and probably on all of the clay soils upon which rice may be grown, it may be necessary to apply water to germinate the seed. A seed bed on these soils loses its moisture very quickly. Under normal weather conditions a good seed bed on soils of lighter texture may not require the application of water for germination. Such soils, if well drained, would probably permit very early planting, which, in California, will always be an advantage.

Great care should be taken in irrigating to obtain germination. Soil and atmospheric temperatures are usually low at this season of the year, and if the water is left on the land too long the seed is likely to rot. Before the plants

come up, water should not be allowed to remain on the land longer than 24 to 48 hours after each irrigation. After planting, the soil should never be allowed to dry out. This will require frequent irrigation, and a supply of water should always be available and abundant enough to meet general requirements.

Tests at the Biggs Rice Field Station indicate that the land should be submerged for approximately 30 days after the plants have come up and that the best depth of water is from 5 to 6 inches. This depth should be maintained until the heads (botanically called panicles) are well turned down, when the fields should be rapidly drained.

Paying crops of rice cannot be produced without submerging the land continuously for a period of several months. The growing of rice on soil that is merely kept moist and not submerged should not be considered seriously.

The amount of water required to make a good crop of rice will depend largely upon how well the outside levees have been constructed and what quantity of water is allowed to flow through the field. Poorly constructed outside levees are responsible for the loss of much water by seepage. The loss is further increased by allowing too much water to flow through the fields in an effort to keep the field water fresh.

The levees that inclose the field should be firm and compact. If they are next to a field that is not under irrigation, they should be very broad. Seepage is greater through levees that are constructed of black adobe soil than through levees that are made of other types of clay.

After a field has been submerged, no more water should be admitted than is needed to maintain the required depth. This will be rather small if there is no loss through seepage. The overflow of water should be no more than a mere film. From many fields it is often several inches. This is an extravagant use of water and should not be practised. The field water will not become stagnant if freshened only once in 10 days.

Too much attention cannot be given to levees and to the delivery and discharge of water. Payment for water should be based upon the volume delivered. Upon this basis it would be more economically used, other conditions being equal, than could reasonably be expected when sold on a flat charge per acre.

On commercial fields of rice where the water was accurately measured during the last season in co-operation with the office of irrigation investigations of this department, the amount used on adobe soil in the vicinity of Biggs varied from 4·65 to 8 acre-feet. This range is too great, but more data must be obtained before definite statements can be made regarding the quantity of water that may be necessary to produce a crop of rice under California conditions.

One 40-acre field which produced a yield of 6,000 pounds of grain per acre received 4·65 acre-feet of water. This field had well-constructed levees and was carefully watered. The other fields did not have the levees so well constructed and were not so carefully watered. It is safe to conclude that faulty levees cause the loss of much water and that a waste of water can be prevented by giving daily attention to the manner of its application.

A field of ripe rice should be rapidly drained. This is very necessary in order to harvest the crop at the least expense of time and labor and to prevent the loss of grain. Boggy fields will delay harvesting, and this delay will invariably result in reduced yields from the shattering of the grain.

It is just as important to provide means for the removal of irrigation water from a field of ripe rice as it is to provide means for supplying water to the growing crop. This is not appreciated as it should be. There are difficulties, it is true, but these can be overcome. It is an engineering problem, requiring community co-operation, and can be readily solved by the creation of drainage districts.

The natural drainage facilities of the level land upon which rice is grown are always overtaxed. It is often the case that little or no field drainage can be had until outlets have been made, and the success of these depends upon their connections with watercourses of sufficient capacity. Poor drainage, or the lack of drainage, results in underproduction through the waterlogging of the land and the accumulation in the surface soil of harmful salts, commonly called alkali.

After their construction, drainage ditches need constant attention. They must be kept free from all kinds of obstructions, especially weeds, which grow luxuriantly in them, or their efficiency will soon become greatly impaired.

It should be remembered that a well-ærated soil is just as essential for rice as for any other crop, if maximum yields are to be maintained.

GREEN-MANURING BEFORE PADDY.

ROBERT G. ALLAN.

This has been experimentally tried at Raipur. The green crops used are *san* and *daincha*. The former is the more rapid; the latter though standing the constantly water-logged state of the land better is very slow in the early stages. Both are sown at the break of the monsoon. As far as his memory goes the writer has never seen a tall, thick, or heavy crop of either at the time of inversion. Indeed the stand has generally been poor. Inversion takes place before transplanting.

The following is a tabulated statement of results obtained here to date. In all cases transplanting has immediately followed ploughing in, the first series being so treated at the beginning of August and the second about the middle of that month.

	1911-12 Paddy.		1912-13 Paddy.		1913-14 Paddy.		Average	
	Grain	Straw.	Grain	Straw.	Grain	Straw.	Grain	Straw.
(1) San	570	550	860	850	810	790	747	730
Sawri (Daincha)	680	610	610	630	910	920	733	720
No manure	450	433	500	440	640	560	530	517
(2) San	490	460	880	840	700	810	690	703
Sawri	500	500	690	640	800	910	617	683
No manure	360	370	610	640	470	450	460	487

Average of san over no manure ... 223 lb. grain
,, sawri ,, ... 203 ,,

The results of two years prove *daincha* to be a little more satisfactory than *san*. In 1912-13 the monsoon was late and *sawri* was only some 5 inches high at the time of inversion. In the other, rather wetter, years the *san* suffered more from water-logging. Inversion and transplanting at a later date do not appear to add to the outturn; though as a consequence of delay, a slightly bigger crop may be inverted, yet the late transplantation probably affects the tillering of the paddy. The writer ventures to suggest that a better method, where irrigation is available in the hot weather (which is not commonly the case in the Central Provinces), is to start the green crop a fortnight or so before the general break of the monsoon. *San* once established is capable of standing more water.

San has also been used over all the manurial paddy series on the farm to raise the fertility of the unmanured plot without altering its relative fertility in the series.

There has been a general improvement over the series, but the relative values of the manures applied in the series do not appear to have been maintained; in five out of six plots in which bone dust has been applied with artificial, the effect of the combination has been extraordinary. This is in line with HOPKIN'S system of maintaining soil fertility and MEGGITT'S note to the Board of Agriculture in 1911.

The following figures to illustrate the point are taken from the RAIPUR FARM REPORT, 1912-13:—

Series transplanted paddy without irrigation.

	Before green-manuring.	After green-manuring.	Average increased yields of phosphate plots due to green manure.
	lb.	lb.	lb.
Average yield of plots to which phosphate was applied	1,490	2,043	—
Average yield of plots to which no phosphate was applied	1,346	1,412	—
Average increase due to phosphate	144	631	487

1912-13.

Series irrigated transplanted rice.

	Before green-manuring.	After green-manuring.	Average increased yields of phosphate plots due to green manure.
	lb.	lb.	lb.
Average yield of plots to which phosphate was applied -	1,199	1,773	—
Average yield of plots to which no phosphate was applied	1,067	1,277	—
Increase due to phosphate -	132	496	364

1913-14.

Series of transplanted paddy without irrigation on different plots from those used 1912-13.

	Before green-manuring.	After green-manuring.	Average increased yield of phosphate plots due to green manuring.
	lb.	lb.	lb.
Average yield of plots to which phosphate was applied ...	1,504	1,603	—
Average yield of plots to which no phosphate was applied ...	1,386	1,281	—
Increase due to phosphate ...	118	322	204

The only artificial manure in the rest of the series which has apparently been affected by the presence of the green manure and has reacted on the paddy is calcium cyanamide.

	Before green-manuring.	After green-manuring.	Increased yield due to green-manuring.
	lb.	lb.	lb.
Average of 3 plots dressed with calcium cyanamide -	1,005	1,240	235

Generally speaking, green-manuring pays in paddy cropping and can be recommended for practice. Probably the results are enhanced if the sowing of the green crop can be done before the monsoon and if the green-manuring treatment is accompanied by the use of phosphates, which in the opinion of the writer are best applied at the time of sowing the green-manure crop.—AGRICULTURAL JOURNAL OF INDIA.

TOBACCO.

INFLUENCE OF SOIL ON TOBACCO IN JAVA.

N. H. COHEN.

The writer made chemical and mechanical analyses (the latter according to E. C. JULIUS MOHR'S method—cf. O. DE VRIES : MEDEDEELING VAN HET PROEFSTATION VOOR TABAK No. 1)—of samples of twenty tobacco soils in the island of Java. The samples were taken to a depth of 9 inches for the surface soil, and from 9 to 15 inches for the subsoil ; the following determinations were made : potash soluble in 25 per cent. hydrochloric acid ; phosphoric acid ; lime (surface soil only) ; phosphoric acid soluble in 2 per cent. citric acid ; lime soluble in 10 per cent. ammonium chloride. Determinations for the tobacco included : ash, potash, phosphoric acid, lime, magnesia and chlorine ; in addition, the exact colour of the ash was determined by a scale of 10 shades of grey obtained by mixing 5, 10, etc., up to 50 per cent. of animal charcoal with calcium carbonate.

The results obtained are summarised as follows :—

1. The citric-soluble phosphoric acid decreases as the soil becomes heavier and more disintegrated.

2. The content of so-called "available" lime in the various soils is proportional to the amount of the "very fine" fraction of the soil.

3. The proportion between the lime soluble in 25 per cent. hydrochloric acid and the amount of "available" lime is in inverse ratio to the amount of "very fine" soil and approaches unity.

4. There is no connection between the amounts of potash present in the tobacco and the soil respectively.

5. There seems to be some relation between the amount of phosphoric acid in the tobacco and in the soil ; heavy soils poor in citric-soluble phosphoric acid produce a tobacco with a lower phosphate content than tobaccos grown on light soils.

6. There is a certain connection between "available" lime in the soil and the lime content of the tobacco.

7. In the case of the tobacco, no connection could be established between chlorine and potash contents and combustibility.

8. On the other hand, some connection exists between the lime content and the colour of the ash ; the higher the lime content, the lighter the colour of the ash.

9. There is no certain connection between the amount of magnesia present in tobacco and the colour of the ash.—BULL. OF THE INT. INST OF AGRIC.

TOBACCO GROWING IN CEYLON.

The expert planter and curer appointed by the Ceylon Government to carry out the experimental cultivation of tobacco seems, after a year's work, to have produced a cigarette which the Governor of Ceylon describes as "quite a good smoke" and a coarse cut pipe tobacco of a quality good enough to guarantee a ready sale. The cigarettes can be marketed at Rs. 2 a hundred, and altogether there seems to be ground for optimism in regard to the future of the "weed" in Ceylon. It may never become a staple, but the disturbance of the output of the Kavala district in Macedonia as a result of the existing and recent wars would seem to indicate the present as a golden opportunity for the Ceylon product to establish itself. If the cultivators are as successful as the Government expert has been, they would find a big market at their doors in India, and the fact that no "Turkish" tobacco is manufactured nearer Colombo than Cairo would seem to indicate another possible market east of India if not also westward up the Gulf, along the Shatt-el-Arab, and in South Africa.—The Indian Agriculturist.

RESEARCHES ON THE CURING OF TOBACCO IN JAVA.

Experiments were carried out in a drier of somewhat primitive construction heated by a wood stove and ærated by a horizontal electric fan. In spite of the provisional plant, it has been shown that if the temperature and moisture are well regulated in the interior of the drier, the curing proceeds normally and the flexibility of the leaf is maintained to the end; the chief condition of success appeared to be the hermetic closing of the drying-shed. It was found that the air could be kept moist by passing it through a series of pieces of sufficiently thick cloth continually steeped in water; sprayers gave no results. The experiments will be repeated in a more scientific manner to discover whether it is possible to regulate the processes of tobacco curing.

Previous experiments on the influence of differently coloured light and of darkness upon the development of tobacco leaves, published by the writer (H. Jensen) in 1903, showed that plants placed in darkness and exposed to green or blue light begin after a time to suffer from lack of assimilation, while the function of respiration is less affected. It was, therefore, to be expected that during the first period of curing (while assimilation and respiration are still going on in the detached leaf), light would have some effect upon the process, and consequently upon the product, and that during the second period (while the leaf is changing colour) light might also play an important part in the little-known alterations that take place. Very careful experiments, however, made both in an ordinary drier and in the laboratory, have revealed no difference in quality or colour between leaves dried in darkness and those dried in daylight or green light. It therefore seems unnecessary to illumine the drying apparatus with green light or to keep it in the dark as is nearly always done.—Bulletin of the Int. Inst. of Agric.

SUGAR.

THE SUGAR QUESTION IN MYSORE.

ALFRED CHATTERTON.

The Mysore State is one of the Provinces of India which produces more sugar than is consumed locally and consequently in normal years the exports are in excess of the imports. During the last 14 years the excess value of exports over imports amounts to 105·7 lakhs of rupees as shown by the following table :—

Years.		Exports.	Imports.
1901—15	Sugar	45·5 lakhs	87·9 lakhs
	Jaggery and Molasses	238·7 ,,	90·6 ,,
	Total ...	284·2 lakhs	178·5 lakhs

From this statement it will be seen that the imports of refined sugar exceed the exports whilst the exports of unrefined sugar and jaggery greatly exceed the imports. Since the closing down of the Refinery at Goribidnur, sugar is not made in the State and the whole of the cane crop is converted into jaggery. Every year a considerable quantity of molasses is imported chiefly from Java for the manufacture of Arrack at the Government distillery. Previous to the outbreak of War in August last year, the price of jaggery averaged about Rs. 1-8-0 per maund of 25 pounds. At the time of writing, it ranges from Rs. 3-8-0 to Rs. 4 per maund in the Bangalore bazaar ; that is to say, it is about $2\frac{1}{2}$ times the price at which it stood fifteen months ago. In consequence of this enhancement of the price, the cultivation of sugar-cane has been greatly stimulated and the area under cultivation this year is much larger than usual. Further, the season so far has been a favourable one and there is every prospect of a bumper crop being realised at the beginning of next year. It is hardly probable that prices will be maintained at their present level, but it is a practical certainty that they will be very high and the sugar-cane growers in this State should realise large profits.

From the statistics of sea-borne trade published by the Government of India, I have extracted the following table showing the value of the imports of sugar into India for the last four years and the average price per hundredweight at the place of importation for what is known as "Sugar, 16 Dutch standard and above."

Year.	Value.	Price per Cwt.
1911-12 ...	16·94 crores	11·10 rupees
1912-13 ...	14·28 ,,	10·11 ,,
1913-14 ...	14·96 ,,	8·92 ,,
1914-15 ...	10·53 ,,	11·43 ,,

The figures for 1914-15 are also given separately from April to July under peace conditions and from August to March when War prevailed. Finally the figures for the first six months of 1915-16 are also given and

those for August and September separately.

		Value.	Price per Cwt.
April-July 1914	...	2·45 crores	8·83 rupees
August 1914-March 1915	...	8·08 ,,	12·57 ,,
April-September 1915	...	7·59 ,,	15·52 ,,
August 1915	...	2·58 ,,	15·44 ,,
September 1915	...	1·53 ,,	15·6 ,,

For many years the imports of sugar into India have been steadily increasing and reached the maximum value of 14·96 crores in 1913-14 when the average price for sugar was 8·92 rupees per hundred-weight. During the first four months of 1914-15 the imports of sugar were valued at 2·53 crores of rupees and the average price was 8·83 per cwt. During the remaining eight months of the year under War conditions the imports were valued at 8·08 crores of rupees and the average price rose to 12·57 rupees per cwt. During the first six months of the current year, that is from April to the end of September the imports were valued at 7·59 crores of rupees and the average price was 15·52 rupees per cwt. The recent heavy shipments and the enhanced price combined with the very high local rates for jaggery suggest the conclusion that owing to the short crops of last year and the serious decrease in the weight of sugar imported, the stocks in the country are much below their usual level. It is noteworthy that, whilst the price of imported sugar has risen by 75 per cent., the value of jaggery has, at any rate locally, risen by nearly 150 per cent., so that at the present moment, the rates for jaggery and sugar are practically the same.

It has been necessary to enter into these statistical details to exhibit clearly the favourable position in which the sugar-cane growers in India are now placed. For many years past it has been asserted that sugar growing in India was doomed to extinction unless adequate measures were taken to protect it against foreign competition. The effect of the War is to give the sugar-cane grower of India an extraordinary measure of protection and it behoves those who ask for a protective tariff to stimulate the growth of the industrialism in India, to show what can be done now that circumstances have so far favoured the sugar industry as to afford it a measure of protection equivalent to the imposition of an *ad valorem* duty of more than 50 per cent. As an excuse for doing nothing it will doubtless be alleged that the measure of protection now obtained is a very uncertain quantity and will be enjoyed for a very uncertain time. The idea of "making hay while the sun shines" is not congenial to the somewhat pessimistic temperament of the people of this country and the golden opportunity for putting new life into the Indian sugar industry will be lost unless energetic action is taken by those who are entrusted with the duty of developing the agricultural and industrial resources of the country.

During the last three years in Mysore, in the Department of Industries and Commerce we have been carrying on experiments to discover practical methods of improving the manufacture of jaggery whilst simultaneously in the Agricultural Department much has been done to encourage better method of cultivating sugar-cane, chiefly in the direction of more intensive cultivation by the use of suitable manures. The time has now come when we ought to

reap the reward of our labours and an extremely energetic policy should be pursued with a view to enabling the ryots, who grow sugar-cane, to avail themselves of the results of the work which has been accomplished. There are two main things to be done :—

(1) The ryot should manure his sugar-cane very much more heavily than he has hitherto been accustomed to do.

(2) The sugar-cane crop when it is ripe should be crushed in power-driven mills so as to avoid the heavy loss due to imperfect and delayed crushing of cane which always occurs when a heavy crop has to be dealt with.

Two cardinal facts stand out as the result of recent work: The first is that the average sugar-cane crop can be more than doubled by the liberal use of manure and that the enhanced value of the crop is greatly in excess of the cost of the manure. The second, that the milling of sugar-cane and its manufacture into jaggery by country methods is a very heavy burden on the ryots and that, in consequence, it is done badly.

In this article I do not propose to go over the ground which has been covered in the Bulletins on Jaggery Manufacture which have been issued by the Industries and Commerce Committee and by the Agricultural Research Institute, Pusa. It must now suffice to state that as a result of our experimental work, we have evolved a system of manufacturing jaggery in small power-driven mills, the use of which will enable the sugar-cane growers to obtain 30 per cent. more from their cultivation than they have hitherto done. It may I think be assumed that in the Mysore State the ryots have now arrived at a point at which they recognise the value of the work done in the Department of Agriculture and Industries; but unfortunately owing to lack of capital they are not in a position to carry out the reforms which would so greatly enhance their profits. It is here that a paternal government should intervene and provide facilities for financing the ryots. To some extent this is being done by the Mysore Durbar and doubtless, as time goes on and experience accumulates, the scale of operations will be increased. Ordinarily, it is desirable to let things develop naturally, but in time of war exceptional conditions prevail and more energetic measures are justifiable than would be the case under normal circumstances. Already the Agricultural Department has, on a tentative scale, established manure depots chiefly for the sale of oil-cake and the same is disposed of to the ryots on credit, the cost to be paid when the crop is put on the market. There is practically no financial risk to Government and the price at which manure is sold can be so fixed that the working of the Depots will involve no loss. All that is necessary is to extend the scale of operations, and the only real difficulty in doing this will be to secure at comparatively short notice sufficient stocks of oil-cake. Here every transaction will be with individual ryots and there should be no more trouble in collecting outstandings than there is in collecting the ordinary land revenue.

The introduction of power mills is not quite such an easy matter except when individuals are willing to set up a complete plant themselves. In such cases, the machinery may either be furnished by Government on the Hire Purchase System or Taccavi loans may be granted to defray the cost. In all other instances it will be necessary for a number of ryots to combine to set up a power-driven mill and the simplest procedure is for them to form themselves into a Co-operative Society with limited liability. Their joint credit is

then good enough to enable the Durbar to advance the money necessary to establish the plant. To deal with from 20 to 30 tons of cane a day, or with about 100 acres of fairly good cultivation in a season, the capital outlay will be about Rs. 12,000 and the gross value of the jaggery turned out about Rs. 60,000. By indigenous methods of milling the ryots are hardly likely to realise more than Rs. 45,000, so that in a single season at the present abnormal prices and after allowing for working expenses the capital outlay on an installation will be almost entirely recovered. Obviously, then, it is desirable that where there is a sufficient area of sugarcane, Co-operative Societies should be started to take advantage of the terms offered.

There are at the present time in the Mysore State ten sugar-cane crushing plants driven by gas or oil engines, and it is anticipated that about ten more will be started during the next few months so as to be in time to deal with the crops of the present season: that is to say, we may expect shortly to have 20 installations at work to mill by modern methods the cane grown on between two and three thousand acres. The area of sugar-cane grown in the State will probably be nearly 50,000 acres this year. A good deal of this, probably one half, is grown on small isolated patches insufficient in extent to justify the establishment of power-driven plants. Allowing for this, there still remains an area from 10 to 15 times greater than that which will come under the mills already established shortly; that is to say, instead of 20 mills we ought to have 200, and to set up these would involve an expenditure of about 25 lakhs of rupees. This is not a large amount considering that the cane crop of the next season will probably be worth considerably more than a crore of rupees.

For convenience in stating my argument, I have referred only to power-driven installations capable of dealing with 20 to 30 tons of cane a day and costing on an average about Rs. 12,000 each ; but smaller installations than this are possible and it is a practical proposition to put in plants of about one-third the capacity at about one-third the cost. In fact, ultimately, more of these small mills are likely to be established than of the larger plants as there are but a comparatively small number of tracts in which sugar-cane cultivation is so concentrated that it would be possible to secure a total area of 100 acres within a reasonable working distance of a central mill. In the South of India there are very few ryots who can be called "cane growers" though there are many who grow a small patch of cane. The crop is a profitable one but it is exposed to risks and requires capital. When power driven mills supersede the present iron mills worked by bullocks to the same extent that these mills have displaced the indigenous wooden mills, sugar-cane cultivation is likely to be more concentrated.

The area under cane in India is large enough to provide the whole sugar requirements of the country, yet because the methods of cultivation pursued are primitive and the machinery employed in crushing is inefficient, it is necessary to spend 15 crores of rupees a year in procuring a supplementary supply. This supply amounts to roughly one-third of the Indian crop. In normal years that crop is worth probably 40 crores of rupees—the next season's crop is likely to be worth double that sum. That is to say the people of India will have to pay something like 40 crores extra for their sugar or go without. The money will remain in the country, and it is a pity that the cane growers cannot be made subject to a special war tax and half their abnormal profits devoted to the improvement of the sugar industry in India.—MYSORE ECONOMIC JOURNAL.

SOILS AND MANURES.

NOTE ON THE POTASH CONTENT OF CEYLON SOILS AND ITS LIBERATION FROM ITS INSOLUBLE COMBINATIONS.

The potash in Ceylon soils ranges between 0·9 and 2·0 per cent., the latter being unusually high. It has been derived from the decomposition of the felspar and mica of the gneiss and other metamorphic rocks comprising the mass of the hill districts of Ceylon.

The composition of these rocks varies largely, but two distinct types of gneiss rock are well known, light and dark coloured, and generally tea grows more freely in soils derived from the latter. COCKRAN published three or four analyses of typical Ceylon rocks and the chief ingredients are as follows :—

	Light coloured gneiss rock.	Dark coloured gneiss rock.	Ferruginous gneiss.	Ceylon Orthoclase
Lime	1·2	9·5	1·5	·5
Magnesia	·2	3·5	·5	1·7
Potash	3·8	·8	1·5	6·7
Phosphoric Acid	·2	·3	·4	0·5

The dark coloured gneiss, amongst which tea does so well, is rich in lime but poor in potash, while the light coloured rock is poor in lime and fairly rich in potash. Further variation is seen in the ferruginous gneiss and orthoclase felspar, the latter being particularly rich in potash.

The soils resulting from these rocks—and for the most part Ceylon soils generally are formed from the decomposition of the rocks in situ—naturally vary in their mineral composition and some are rich and some poor in potash.

Even when the rocks have disintegrated, the potash is for the most part still insoluble in the soil fragments as silicates and hydrated silicates or zeolites, but it can be attacked by the roots of plants, and gradual weathering liberates small quantities annually for the crops.

The application of quicklime to the soil assists in this liberation, but for tea particularly too much lime is inadvisable, though for rubber more can be applied especially to swampy and sour soils.

In most tea estates cultivation by forking, burying prunings, etc., has now been carried on for several years together with manurial applications containing far more potash and phosphoric acid than is removed by the sale of the produce. The cultivation has also assisted in breaking down the insoluble silicates and liberating some of the potash for the use of the tea so that in all probability there is ample potash at the disposal of the bushes for some time to come.

From experiments conducted with tea and to a less extent with rubber, the indications are that potash has not the importance usually ascribed to it, and which it has no doubt partly gained from the constant advertisement given to it by the German Potash Syndicate, whose business was to sell potash.

Taking an average potash content in the finer portion of Ceylon soil at about 0·150 per cent., or say 0·075 per cent., on the whole soil, this represents roughly 5,250 lb. of potash per acre in the top 2 feet of soil. At least one-tenth of this is fairly available in a well cultivated soil, or 525 lb. of potash; so that given sufficient nitrogen and phosphoric acid, and a little lime to promote nitrification of the large amount of green manure loppings and leaf tea prunings now being constantly returned to the soil, potash may well be temporarily omitted from mixtures without much fear of loss of crop or deterioration of the wood of the bushes.

The amount of potash removed from the soil by 1,000 lb. of tea is about 21 lb. and the amount of potash returned to the soil from a two-yearly pruning of good jât bushes is about 48 lb., besides 102 lb. of lime, i.e. provided the prunings are forked in or buried and the wood is not removed.

With regard to the application of lime to tea to liberate potash or for other purpose, the manurial experiments at Portswood and Dessford show clearly that while so much as 1,000 lb. per acre (half quick-lime and half ground lime) did harm to the bushes and reduced crop, 500 lb. per acre of the same mixture applied for several consecutive years did good, the increased crop being almost equal to an application of 750 lb. per acre of ordinary mixture and costing only about one-third of the latter. There is an impression that one of the effects of the comparatively large applications of potash salts in recent years has been to increase the proportion of red stalk and fibre in the finished tea. It is quite possible, and the omission of potash from mixtures for a year or two should help to prove the point.

It should be remembered that the effect of applying potash salts such as Kainit, Muriate and Sulphate of Potash is not confined to supplying so many pounds of potash to the soil, as they often have a harmful chemical effect especially if dilute solutions of these salts come in contact with carbonate of lime. Dr. VOELCKER as long ago as 1864, showed that under such conditions the alkaline carbonate of potash was produced, which injured the physical character of the soil by causing deflocculation of the clayey particles. The remedy is always to include superphosphate of lime in such mixtures.

There is little risk of potash salts being washed out of the soil, as under ordinary conditions there is an interchange of bases in the zeolites of the clay; potash combining in the zeolite and becoming insoluble and an equivalent amount of other bases such as lime, magnesia and soda being liberated to combine with the acid of the potash salt, which is then more or less washed out of the soil. At Rothamsted it was shown that carbonate of lime was being washed out of the soil at the rate of 600 to 1000 lb. per acre per annum.

M. KELWAY BAMBER.

PHOSPHATIC MANURES.

R. E. ALEXANDER.

Experiments on manuring have demonstrated one peculiarity at least in Australasian soils, and that is the fact that all crops respond to a dressing of phosphates. This fact may be taken as an indication that the average Australasian soil is deficient in available phosphates. A manure for any crop,

therefore, should have phosphates for its basis. Phosphates may be got from two or three sources, and, depending on the source, may be divided up into at least two classes:—Manures containing available or soluble phosphates, and those manures containing slow acting or insoluble phosphates. There might be an intermediate class containing reverted phosphates, i. e., phosphates which have been soluble and quickly become soluble in the soil. Then again, phosphatic manures might be divided into acid, non-acid and neutral manures.

The term soluble phosphates implies that the phosphates are soluble in water, and can be obtained by the plant at once.

Reverted phosphates have lost their solubility, but as a rule are quickly changed in the soil and soon become available.

Insoluble phosphates are insoluble in water, and may only change slowly.

Acid phosphates are those which give an acid re-action under the chemical test.

Non-acids are those distinctly non-acid, and neutral are those that are neutral to the test.

The chief source of soluble phosphates in New Zealand is superphosphate, which is obtained by acting on mineral phosphate with sulphuric acid. It is an acid manure, therefore, and the percentage of phosphates varies in proportion to the purity of the original mineral phosphates. The terms high and low grade are used in regard to superphosphate. A low grade super contains less than 3% phosphates, and besides this, the impurities may be objectionable; it is not, therefore, as valuable lb. for lb. of phosphates as a high grade, which may contain up to 40 and 42% phosphates, with little or no impurities. In a high grade super, most phosphate is obtained per ton, and where carriage is an important item, it is better to get the highest grade and so save carriage. Values of the different grades are easily estimated; if 40% super costs £4 10*s*., then 36 % super is worth £4 1*s*., and 30 % super £3 7*s*. 6*d*. but if there is carriage to put on to this, the high grade becomes the cheapest, as it costs no more per ton to carry than the low grade. All the phosphates, in a mineral phosphate, are not acted on in the process of manufacture,—sometimes, whether by accident or design, too large a percentage is acted on and the resultant superphosphate is a pasty, sticky mass. A farmer has no means at his disposal of drying this pasty or damp super and so he would be wise not to buy it. Damp super, as a rule, contains free acid, and is very severe on the manure drill. The continuous use of super tends to make lands acid or sour, especially on our Canterbury lands, where lime is present in a very limited quantity. None of our farm crops thrive well on acid lands; where super is used constantly, liming occasionally would be necessary, or at least where possible use of the non-acid phosphatic manures. The analysis of super is sometimes given as a percentage of phosphoric acid equal to tricalic phosphate. This is practically the same as stating that two sixpences equal one shilling, and as it is easier to compare values as phosphates, the phosphoric acid can be reduced to phosphates by multiplying by 2·2, or to be exact, 2·18; thus a super guaranteed to contain 18% phosphoric acid, contains 39·3 phosphates.

Animal refuse and bones all contain insoluble phosphates which are slow acting (bones from 40 to 50%). These manures are neutral in their chemical action, but develop a certain degree of acidity or sourness as they break up or

decay in the soil, so that a change to non-acid manures where possible or a liming would be necessary, where animal manures have been continuously used.

Basic superphosphate or basic super is made by mixing superphosphate, that has had the highest possible proportion of its phosphates rendered soluble with lime, which acts as a drier, and so the mixture is as a rule in a very good condition for sowing. The phosphates in basic super are either reverted or insoluble, but soon become soluble in the soil. There is also, in basic super, about one-third of its weight of lime, which can function as lime in the soil. It is therefore a non-acid manure, but slower acting than ordinary super. An application of basic super to autumn or early sown crops would reduce the acidity in the soil. It might be used to advantage in place of super to such crops.

Basic slag is a bye-product in the manufacture of steel from phosphatic iron ores. The blast furnaces into which the ore is run in the final process of smelting are lined with lime, and lime is introduced with the molten ore. At a very high temperature the phosphates, which would render the iron useless, unite with the lime, forming basic slag, which is run into the slag pits as the ore is run into the moulds. This basic slag is ground to a very fine state of division and sold as a manure. Some iron ores contain no phosphates, and the slag from such ores would be useless. Other ores again contain a very small percentage of phosphates and so produce low grade slags, which are objectionable for two reasons, namely for their high percentage of impurities, and for their insolubility. High-grade slags containing from 30 to 40% phosphates (if the analysis of a slag is given as so much phosphoric anhydride or phosphoric acid, the equivalent phosphates can easily be calculated by multiplying the phosphoric anhydride or acid by the factor 2·18 already given) are the most desirable from a farmer's point of view; they contain less impurities (the impurities in slag, especially low-grade slags, are more or less injurious) and are as a rule more soluble.

When purchasing basic slag it is essential to attend to the following points and get a written guarantee: (1) Percentage of phosphates. Some slags are worthless and extensive frauds have been perpetrated on farmers by unscrupulous individuals selling them such slags. A guarantee of the percentage of phosphates should always be insisted on. It is easy to compare prices of the different grades by methods already given for super. (2) Insist on getting guarantee of fineness. Slag has been formed in the blast furnace at a very high temperature and unless it is very finely ground it is useless to the farmer. The guarantee should be, that at least 85 % will pass through a sieve with 10,000 holes per square inch—this is generally given as fineness, 85%. (3) The analysis of a slag should also state the solubility of the phosphates in a 2 % solution of citric acid, and a good slag will have a solubility of from 80% to 90 %. Since 1906 this test has been insisted on by the English Board of Agriculture, and at least one experimenter asserts that slag, with such a solubility is as quick-acting on certain soils, as super. It is also essential to see that slag is absolutely dry and it must be kept dry or its fineness will be destroyed. (The Boards of Agriculture have adopted the WAGNER test, i.e., the percentage of phosphates soluble in 2 % solution of citric acid in a given time, namely half-an-hour).

The best results are obtained from slag on boggy land and heavy land deficient in lime. The results on light shingly land are very doubtful. When top-dressing lands with slag, it is not advisable to apply slag if the lands are sodden or if there are pools of water lying about; but on the other hand, poor results are often obtained from slag in a dry season. The explanation is that there is not sufficient moisture in the soil to render the slag soluble. It is generally recommended that slag should be sown in the Autumn or early Spring. If sown in the late Spring, it should be well worked into the ground, the object being to get it either washed into the soil or into intimate contact with the soil, so that it may be acted on.

This question is often asked, "Which is the most valuable, slag or super?" Formerly, soluble phosphates in super were considered to be 1½ times as valuable as insoluble phosphates in slag, and many people value them still on this basis, but this is leaving all consideration except water solubility out of the question. When we want to grow a crop there are other considerations besides the availability of the plant food, one of them being the acidity or non-acidity of the soil. If the soil is in the least degree acid or sour (and all rich soils have a tendency to get sour unless there is a plentiful supply of lime in them, or lime is frequently applied), the comparison between the phosphatic contents of superphosphate and the slag do not apply when considering a manure for such a soil. Basic slag or basic super would be the most suitable manure, irrespective of the fact that the phosphates in them might cost nearly as much as superphosphate. The question a farmer has to consider is, which of the phosphatic manures will suit his land the best, and not altogether, which is the cheapest per lb., of phosphates. At the present time in England, there is a controversy going on which is described by someone as the "Battle of the Phosphates," and quite a number of reliable experiments have been quoted, showing that even to Spring crops as good returns have been produced from the application of basic slag as superphosphate, and the well-known "Cockle-park Grass Experiments" have also shown slag to be equal, lb. for lb., to superphosphate. I do not mean to say that these experiments prove that slag is as good as super, but they are indications that, in some lands, it is not so much a question of the solubility of the phosphates as whether the manure will decrease or increase the sourness of the soil. I have already pointed out that super increases the sourness, and slag decreases it. Just lately, I have been asked should slag and super be mixed? I assume the object was to get rid of the acidity in the super. No loss of phosphates can take place from such a mixture, but then the soluble phosphates in the super are reverted. It should also be remembered that heat will be generated when the mixture is made, and mixing must be done some time before the manure is required for use. I cannot see anything to be gained by making the mixture, as basic super in which is a mixture of superphosphate and lime, can easily be obtained in New Zealand.

Another question I am often asked is "Which contains the most phosphates, 40 % slag or 40 % super?" They both contain the same and there can be no difficulty in comparing slag, super or basic super, so far as the phosphatic content is concerned, the only difference being that the phosphates have not the same solubility.—CANTERBURY AGRICULTURAL COLLEGE MAGAZINE.

CAUSTIC LIME AND LIMESTONE.

Caustic lime produces more rapid decay and therefore a quicker circulation of food stuffs in the soil. It destroys soil pests and neutralises acidity.

Lime to a humus soil accelerates consumption of oxygen and production of carbon dioxide; it also facilitates conversion of unavailable nitrogen to ammonia, but inhibits the production of nitrates (Boussingault). Lime neutralises soil acidity, breaks down some organic compounds and increases the amount of compounds easily resolved into ammonia or capable of serving as food for bacteria. Limestone neutralises acidity but does not decompose complex organic residues.

Lime increases the number of organisms in soil by the more favourable reaction induced. 0·10 per cent. of lime to soil temporarily increases the numbers of bacteria. Observers have noted favourable effect of lime on production of nitrates, also on increasing the availability of bones, dried blood, cotton seed meal and other organic residues. Field soils that have been limed are shown to have an increased amount of nitrate and available potash and phosphoric acid. The presence of lime in the soil is essential for the nitrogen fixing organism *Azotobacter*. It increases the bio-chemical efficiency of bacteria and improves the soil conditions for peptone decomposition, nitrification and nitrogen fixation. Heavy applications of quicklime destroy certain classes of protozoa and nitrifying bacteria, but after an initial depression the total numbers of bacteria were subsequently largely increased and resulted in increased amounts of ammonia and in pot experiments of plant growth.

M. KELWAY BAMBER.

THE SUPPLY OF MANURES.

JAMES HENDRICK, B.Sc., F.I.C.

It is probable that there will be sufficient supplies of nitrogenous manures. In normal times we export over three-fourths of our total production of sulphate of ammonia. Such export will now be restricted, as this and other fertilisers can only be exported under license. Our total production of sulphate of ammonia exceeds 400,000 tons per annum, so that there should be sufficient of this valuable fertiliser available to meet even greatly increased consumption. It is probable that the price will be a little higher than in pre-war times owing to the enhanced price of sulphuric acid, and the increased cost of labour and transport, but it is not likely that the price will be excessive.

There should also be considerable supplies of nitrate of soda. Normally, the German market consumes many times as much of this substance as the British. The Belgians were also heavy consumers of nitrate. These great markets are now closed and practically unlimited supplies are nominally available for the British market. Freights from Chile have, however, risen to an almost prohibitive level. Therefore, though there is plenty of nitrate available in South America, it is probable that the price in this country will be high. At present the price of nitrogen per unit is much higher in nitrate of soda than in sulphate of ammonia. Great supplies of nitrate will of course be required for the explosives industry.

In addition to these two leading nitrogenous manures there will also be supplies of others, such as calcium cyanamide and nitrate of lime. There seems no reason to suppose that the supplies of these will be seriously restricted. At present, calcium cyanamide (nitrolim) is considerably the cheapest of the concentrated nitrogenous manures per unit of nitrogen.

PHOSPHATIC MANURES.

It seems probable that manufacturers will be able to obtain sufficient quantities of raw phosphates, though at greatly enhanced prices. For a time after the outbreak of war there was serious difficulty in obtaining supplies, as contractors for these and other materials almost everywhere took steps to get their contracts cancelled. Further, as the German market was the principal one for high-grade Florida phosphates, many of the mines closed down when this market was cut off. To a large extent, the difficulties seem now to have been adjusted, but the price of rock phosphates will be considerably raised owing to the great rise in freights. Thus, before the war the freight from Florida was 15*s*. to 20*s*. per ton. It is now 50*s*. to 60*s*. per ton, and it is difficult to get bottoms even at these rates.

The cost of sulphuric acid will also be much increased owing to the rise in price of pyrites, the increased cost of labour and the great demand for acid for the manufacture of war materials. There seems also to be some uncertainty as to the supply of acid. The demand for Government purposes has not merely doubled or trebled, but has increased many fold, and it will continue to increase with the increased production of munitions. Though active steps have been and are being taken to increase the supply of acid, and many manufacturers think there will be a sufficient supply, there are elements of doubt and uncertainty in the problem. It is not impossible that there may be a shortage for the manufacture of superphosphates and of other dissolved manures. If so, there will be a more or less serious scarcity of superphosphate. In any case the price of superphosphate will be greatly increased. If soluble phosphate is not scarce it will, at any rate, be dear.

On the other hand, there should be large supplies of basic slag available. As in the case of sulphate of ammonia, part of the basic slag produced in this country is normally exported. Such exportation is, at present, largely restricted, as it is forbidden except under license. Our recent production of basic slag has been a little over 400,000 tons per annum, while our production of superphosphate exceeds 800,000 tons per annum, of which about one-tenth is exported. There are normally available for home consumption about 750,000 tons of superphosphate in this country. The home consumption of basic slag on the other hand is about 250,000 tons per annum. These figures show that if there is a really serious deficiency of superphosphate it cannot be met by the use of slag. Even if we use at home the whole of the slag at present exported from this country, it cannot do more than replace a fraction of the superphosphate at present consumed.

Even if there is a serious deficiency of superphosphate owing to want of acid and labour, there is no reason why our soils should suffer from lack of phosphatic fertilisers so long as we can obtain supplies of raw mineral phosphates. Finely-ground Tunis and Algerian phosphates (and to these may be added Egyptian phosphate, which are now also on the market in bulk) are far more valuable as manures than is generally realised. They can be used for

all purposes for which basic slag is employed, and will give, weight for weight, of phosphoric acid, only slightly inferior result. As they are cheaper per unit of phosphate, a greater weight of phosphate can be applied for the same money than in the case of slag, and still more than in the case of superphosphate. Even apart from war exigencies, ground mineral phosphates deserve far more attention for direct application as manure than they receive.

POTASSIC MANURES.

As our chief supplies of potash manures are cut off, the most important question we have to consider is how we can maintain our crops without supplies of German potash salts. Various recommendations have been made as to obtaining potash from waste organic materials like hedge clippings, bracken, and waste timber, bark, twigs, and similar forestry by-products. All of these are useful, and where it is practicable to obtain ash from such materials they should not be neglected. No large supplies, however, need be looked for from these sources. A more hopeful source of potash supply is to be found in seaweed. Even in peace time a certain amount of seaweed has always been burnt in Scotland and Ireland, and the ash, or kelp, sold to chemical manufacturers, who extract potash compounds and iodine from it. The production of kelp is a poor, badly-organised industry, found only among the crofters of the Islands and West Coasts of Scotland and Ireland. It is difficult to revive this decayed industry, but the writer believes that under present conditions greatly increased supplies of potash might profitably be obtained from seaweed.

Before leaving this subject it may, perhaps, be pointed out that the direct use of seaweed as manure is well worth the consideration of all farmers within reach of the coast. As potash has risen to about four times its pre-war price, seaweed is much more valuable per ton as manure than it was, and it is better worth while to incur some expenditure in saving and carting it to the land.

An immense amount of potash is at present lost in liquid manure. It is not generally realised that liquid manure is far richer in potash than in any other manurial constituent. As a result of 35 analyses of liquid manure obtained from farms in the North-East of Scotland, the writer found that the percentage content of potash is, on the average, more than twice the percentage of nitrogen. There are, naturally, great variations in composition, and in exceptional cases the nitrogen was higher than the potash, but in nearly all cases the potash was higher than the nitrogen and generally very much higher.

Most of the potash in the food of stock is excreted in the urine, and the liquid which drains away from the dung heap is very rich in potash. If all the urine of stock, and all the liquid manure which drains away from the dung heaps were saved and used as manure, it would largely do away with the necessity for the use of special potash manures, and would also supply much nitrogen to the soil. With potash at its present high price, the waste of liquid manure is almost criminal.

Liquid manure can be applied to the land in various ways. It may be soaked up in absorbent organic materials like peat moss, leaves, bracken, and other waste vegetable material, where such can be obtained, or it may be sprayed direct on the fields in the form of liquid. In any case it should be well distributed. Part of the prejudice which seems to exist against it in the

minds of farmers appears to have been caused by its excessive use on limited areas easy of access. Farmyard manuring itself will do harm if applied in excess to limited portions of land, and no farmer thinks of applying it only to a few spots which he can get at easily.

Other methods which may be used to help the potash supply on certain soils are the use of soda salts, such as common salt, and nitrate of soda, and the use of lime. These manures are of use only on soils which naturally contain considerable supplies of potash locked up in insoluble forms.

CALCAREOUS MANURES.

There is no danger of the supply of lime being cut off owing to the war, but there is a danger that owing to scarcity of labour and difficulties of transport supplies may not easily be obtained when they are wanted, especially if farmers do not order early and leave as large a margin of time as possible for obtaining delivery. In many districts of the country lime, whether in the form of carbonate or of burnt lime, is far too little used. In order to increase our crops during this time of stringency and high prices, greatly increased amounts of carbonate of lime and of burnt lime should be used over large parts of the country.—JOURNAL OF THE BOARD OF AGRICULTURE.

HOUSE FLIES AND HORSE MANURE.

A valuable account of a simple means of preventing manure heaps from becoming breeding grounds for flies is published by M. E. ROUBARD in COMPTES RENDUS (1915, 161, p. 325); see also PHARM. JOURNAL, October 2, 1915. M. ROUBARD points out that horse manure is the chief breeding ground of the house-fly, and that house-fly larvæ are not found in the manure of cattle or pigs. The eggs are deposited in fresh stable manure which has stood not more than 24 hours. From each cubic metre of such a heap 10,000 flies may hatch, and this number may, under favourable conditions, rise to 35,000. Egg deposition occurs only in fresh stable litter, saturated with urine, and it may continue outside the day after its removal, but not longer; fermentation preventing further eggs from being laid. The addition of substances such as borax, which reduce fermentation, may allow of egg-laying for another day or so. The larvæ hatch out from the eggs and work their way to the surface, leaving the central portion before fermentation becomes vigorous. On or about the sixth day the larvæ descend to the base of the heap, where they pupate. At this time the manure contains no more larvæ, and no more eggs are deposited in it. Inasmuch as the centre of the heap, after the second day, reaches a temperature of 70° to 90° C., and inasmuch as the larvæ are very sensitive to heat, and also to the gases liberated during fermentation, it is easy to destroy them *by burying the exterior portion in the middle of the heap.* Experiments have shown that the house-fly larva is killed by an exposure of three minutes to a temperature of 51° C., and if it be subject both to this temperature and to the gases produced by fermentation, it succumbs in one minute. When the manure heap is turned over the larvæ which fall into the middle are killed instantly. To destroy the eggs, and so prevent the development of flies, all that is necessary is to bury the stable litter as removed in the centre of a fermenting dunghill instead of throwing it on the top.—GARDENERS' CHRONICLE.

CO-OPERATION.

CO-OPERATION IN INDIA.

SIR E. MACLAGAN'S REPORT.

The report of the committee on co-operation in India was published at Simla on September 2nd. It is unanimous and covers 127 pages. The following is a summary of the recommendations:—We have in the first chapter of this report given a brief sketch of the origin and progress of co-operation in India, the passing of the Acts of 1904 and 1912, and the reasons for the constitution of our committee (paragraphs 1—7) with the establishment of central financing agencies. After the passing of the Act of 1912 there arose a special class of difficulties in connection with the co-ordination and financial position of the various parts of the co-operative organisation; and our committee while authorised to examine any important aspects of the movement was intended mainly for the suggestion of measures to meet this class of difficulties. Of the 14,566 co-operative societies in existence in British India in 1914, no less than 13,715 were societies which had been started to provide agricultural credit and in dealing with the question before it the committee has in the main, confined its remarks to those societies which came under this category. Much excellent work has been done by societies established for urban credit, or for objects such as the purchase of instruments and seed, the production and sale of produce, the insurance of cattle and the like, and it is not improbable that the greatest developments of the future will be connected with this class of co-operation. In view, however, of the present preponderance in the number of agricultural credit societies, and the similarity of the general principles which guide all classes of co-operation, we have contented ourselves with a comparatively short examination of the non-credit and non-agricultural credit aspects of the work and have dealt mainly with the institutions established for providing agricultural credit.

These institutions were first left, and we think, rightly left, to develop on independent lines in different parts of the country but the stage has now been reached at which further haphazard development can only be attended by complication and danger. In the forefront of these institutions are the primary credit societies themselves, 13,715 in number, and in some provinces attempts have been made to group those societies for financial purposes into guaranteeing or other unions. Above these societies and unions, balancing their funds and supplying them with capital, are some 189 central banks of various kinds, and above these again, performing in some degree for the central banks the same function that the latter do for societies, we find in five provinces a series of institutions which we have classed together as provincial banks. We have dealt with these three groups of institutions in the second, third and fourth chapters of our report, and in each case we have examined separately (a) their constitution and management; (b) the composition and employment of their capital; and (c) the manner in which

they are audited and supervised. We have enumerated the requirements which have, in our opinion, to be met in order that the primary societies may be truly co-operative in their institution. We have pointed out the extreme care which is necessary in the formation of new societies and have indicated the principles upon which a decision should be reached as regards the area and size of normal societies. We have further urged the extreme importance of systematically inculcating the main principle of co-operation both before and after the registration of a society, and have pointed out the increase in efficiency and financial stability that must result from such teaching. We have described the guaranteeing unions of societies which are found in Burma and elsewhere and have suggested their extension to other provinces, as an intermediary between the society and the central banks.

CENTRAL BANKS.

The central banks themselves are at present of three classes, according as their shareholders are entirely individuals, entirely societies, or partly individuals and partly societies; and, while advocating the disappearance of the first class and the ultimate adoption of the second, we have held that for the present the third, or mixed, form of constitution offers the best advantages, if due provision is made for enabling the co-operative elements to secure once preponderating, and ultimately exclusive control. We consider that for each central bank a definite area, corresponding as far as possible with the administrative units, should be assigned, and we have calculated that the most economical size for a central bank is one that deals with not less than 200 to 250 societies. We hold that all credit societies (or, at any rate, all agricultural credit societies) within the area of a central bank should be shareholders in the bank, and should have no dealings with other financial bodies. To balance the excesses and deficiencies in the central banks and to supply them with funds, we would advocate the foundation at an early date of a co-operative institution at the head of each province which does not possess one. These institutions should, in our opinion, be composed, not of individual shareholders only, but should have a mixed constitution in which individuals and co-operative banks should both be represented, and in which provision should be made for enabling co-operative banks to obtain within a short time the control of the general meeting though not necessarily of the directorate. The constitution, in fact, of co-operative institutions at all stages should, in our opinion, be such as will ensure true co-operation, and such as will secure assistance from middle-class men of education, and, where possible from business experts, without endangering the ultimate object in view, which the concentration of the control in the hands of the co-operative institutions themselves.

The capital of co-operative institutions is composed mainly of shares, deposits and loans, and the liability is usually unlimited in the case of primary societies, while it is always limited in the case of central or provincial banks. We have described the different systems upon which shares are now taken in societies in certain provinces and, while indicating the circumstances under which we would advocate the introduction of a share system where it does not now exist, we have recommended no general change in this respect in the case of individual shareholders in central and provincial banks. We recommend that, as a general rule, there should be

one vote per man and no preference shares or reserve liability, while in the case of societies which hold shares we would make the holdings of the societies proportionate to their borrowings and permit of a portion only of their shares being paid up.

DEPOSITS AND LOANS.

For institutions of all grades the amount of dividend must, in our opinion, be limited and we have indicated the principles upon which the limit should be imposed. Deposits have hitherto constituted, except in the Punjab, a comparatively small portion of the capital of primary societies, and we think that so long as deposits in such societies are of a local character every effort should be made to increase their amounts, all sums received in excess of the needs of the societies being duly forwarded to the control banks. The period of deposits accepted by co-operative institutions of all kinds should ordinarily be for as long as possible, but there are certain circumstances in which it would be legitimate to receive short-term or current or saving deposits. The class of depositors in primary societies differs somewhat from that depositing in central or provincial banks, and we have indicated the difference which this may entail in the arrangements for repayment. We have also stated our views regarding the circumstances in which central banks would be justified in attempting to raise money by debentures. Loans received by the provincial banks from presidency or joint-stock banks, and those received by central banks from presidency, joint-stock or provincial banks, are generally, though not always, in the form of cash credits, and we have pointed out the convenience, and at the same time the uncertainty attaching to this form of advance from banks outside the movement. The advances made by central banks to societies, on the other hand, are ordinarily in the form of a loan for a term, and we have described in some detail the manner in which the credit to societies should, for this purpose be assessed, the periods for which the interest at which, and the security on which loans should be given, and the manner in which their recovery should be enforced. The principles on which societies should in their turn grant loans to members have also been examined by us at some length. We would allow sufficient cash to be kept locally to allow of urgent loans being given, and we recommend the use of promissory notes and of members' pass books. The total borrowing power of the committee, and the normal maximum borrowing power of each member should be assessed beforehand by the societies, and we have suggested the adoption of a system under which the period of a loan should, as a rule, automatically correspond with the object for which it is given.

We advocate the taking of sureties in all cases and the rigorous exaction of the sureties' liability when necessary. While deprecating the extensive use of mortgages, we have stated the circumstances in which we consider them legitimate, and we have suggested the possibility of special concessions being made to societies in the matter of mortgages and liens on crops. We have represented the disadvantages of premature reduction in the rates of interest charged to members and have pointed the way to an ultimate introduction of cash credits to members in place of loans. We have laid special stress on the absolute necessity for introducing a systematic method of ascertaining the amount of loans which are overdue and have not been repaid by members, and the avoidance of fictitious payments of loans.

While advocating the full use of the existing law in respect of recoveries from members we have not supported the claim put forward for a summary procedure, and we have deprecated the use of Government's agency for the recovery of debts due to societies.

RESERVE FUND.

We have further considered the much-debated question of the functions and employment of the reserve fund. We have held that all co-operative institutions should build up a reserve fund, in the sense of surplus assets, and that every effort should be made by each institution to accumulate and own capital to supply its working needs and to meet the claims of creditors on liquidation. But we have also laid great stress on the necessity in the case of all institutions which take deposits to provide for themselves, either by their own investments or by arrangements with other banks, an adequate fluid resource, and in the absence of facilities for discounting co-operative paper. We have suggested that this fluid resource should in central banks be sufficient to meet half the deposits for payment within the next twelve months, a standard of one-third being held sufficient in the case of provincial banks. We consider it advisable that, after satisfying the above requirements, co-operative institutions should be left to utilise their surplus assets in their own business. We recognise that these proposals will, in places, entail a disarrangement of existing financial conditions and will in many cases involve a considerable raising of existing margins but we are convinced that they should be carried out as soon as circumstances permit and before the natural fall in margins renders it difficult, if not impossible.

We have added some miscellaneous suggestions regarding the use of profits for charitable purposes or for the establishment of separate funds, the employment of superfluous money and the introduction of a special procedure for recovering liquidation.

GOVERNMENT SUPERVISION.

We have then drawn attention to the vital importance of proper audit and supervision in the case of central and provincial banks. We suggest that the formal audit of accounts should be done on payment, either by professional or by Government agency, the further examination of the conditions of the banks and their general supervision being entrusted to Government agency. For primary societies the audit should include not only the accounts audit but a further examination, and these duties should be carried out by a staff of auditors approved by the registrar and maintained by the societies themselves, the work of supervision being similarly entrusted to a staff paid for by the societies. The auditing staff would be on a provincial basis and under the ultimate control of the registrar, who would also entertain an adequate Government establishment, on a scale suggested by us, for maintaining a super-audit or second audit of societies. We have added suggestions regarding the use to be made of audit reports, the publication of balance sheets in central and provincial banks and the preparation of annual and quarterly returns.

In our fifth chapter we have examined a special class of questions, relating to the degree in which the co-operative movement should receive administrative and financial help from the Government. We have suggested

no additions to the special concessions permitted by the Act, or to the concessions in respect of remittances, savings bank accounts, etc., which have been departmentally allowed to societies; but we have examined the relation of Government and its servants to the movement. In other respects the rules prescribing the attitude of Government servants, as members, directors and depositors respectively, to the various classes of co-operative institutions appear to us to be generally suitable, but we have recommended some minor changes which appear to us advisable. The relation of the district officers (and in some cases of sub-divisional officers) to the movement has also been re-examined and, while deprecating any devolution to the district officers of duties assigned under the Act to the registrar, or any general arrangement for making him *ex-officio* a director or chairman of the central banks at district head-quarters, we would wish him to be entitled to attend all meetings of central banks in his jurisdiction. We have stated our views as to the scale on which the controlling Government staff should be fixed and we have explained the duties and qualifications required of the registrars and joint-registrars, the status they should hold, the pay and allowances which in our opinion they should draw, and the arrangements which should be made to provide qualified successors for vacancies in the posts as well as for making junior civilians acquainted with the principles of co-operation.

We have further examined a proposal which has sometimes been put forward for the co-ordination of certain economic departments, including those of co-operation, agriculture and industries, under a single officer of high standing in each province and have recommended that a move be made in this direction as opportunity offers. We have then pointed out the need for closer control by Government over the objects for which the co-operative organization is utilized and over the financial arrangements of the movements. To meet the former need we propose certain rules and bye-laws to define accurately the objects and activities of co-operative institutions, and to meet the latter we suggest the appointment of an officer with co-operative experience to act as adviser to the Local and Supreme Governments. Indirect financial assistance has sometimes been given to the movement by the deposit of Court of Wards and other funds over which Government or Local Bodies have control, and we have indicated our opinion regarding the extent to which use might be made of co-operative societies for the deposit of other public or quasi-public funds. We have also suggested that where agricultural loans are being given by Government on a large scale to meet seasonal distress or to provide for the initial expenses of a scheme of colonization, it should be open to societies to receive such loans for distribution to their members, the arrangements for distribution, fixing of interest and recovery being left to the societies, and we have suggested a somewhat similar procedure in the case of large loans to bodies of men for agricultural improvements. We have then examined the effect on the co-operative movement of recent famines, of banking crisis and of the present war, and we have explained that the Government has hitherto given direct financial aid to co-operation in three ways only, viz., (1) by the grant of initial advances to new societies; (2) by guaranteeing the interest on the debentures of the Bombay Central Bank, and (3) by special advances in two provinces to meet difficulties anticipated in connection with the war.

We have expressed our concurrence with the present policy of Government, so far as it represents the rejection of the system of money doles and of

undue concessions, but we have pointed out that in order to make the movement self-sufficing it will be necessary to provide some means of re-discounting the pro-notes societies, either through the Presidency banks or by means of a State co-operative bank, and we have recommended that a careful examination should be made of this question.

In conclusion we desire to take this opportunity for expressing our appreciation of the valuable assistances rendered by our Secretary, MR. R. B. EWBANK, I.C.S. In view of both his personal qualities and of his previous experience as a registrar, he was admirably fitted for his duties in connection with our committee and we are greatly indebted to him for the help which he has given us.—INDIAN AGRICULTURIST.

RURAL CO-OPERATIVE SOCIETIES.

The following letter from MR. B. TIRUMALA CHAR appeared in the MYSORE ECONOMIC JOURNAL for October, 1915:—

A question of great importance in the State of Mysore is to put into practical shape the various ideas of improvements in different directions which are being suggested from time to time. One of these for instance is the idea of a broadcast or universal education, which in spite of the indefatigable exertions of the responsible officers is far from making any headway at all. If there is to be any the least advancement, it can only be effected by individual improvement. If properly handled Co-operative Societies, which are now, thanks to the untiring perseverance of the Registrar with his efficient staff, sufficiently numerous, may form effectual organs for this individual improvement. For this purpose, the societies must first be thoroughly overhauled, and this can be effected, not by repeated inspections and audits by a handful of officers, but only by the education of the members of the societies.

This education of the members is not such a difficult operation as it appears. There are at present in the Department of Co-operative Societies, thirteen permanent inspectors, as many more pro-rata inspectors (?), and an Honorary Supervisor for each taluk which can boast of ten or more societies. It is expected by the department that an inspector will visit each society in his charge at least twice in the year. Practically the Inspector visits most of his societies, now that the jurisdiction of each Inspector is limited, very much more frequently. Most of these inspectors, if not all, are highly educated and are fitted to be excellent teachers, if they are properly instructed. Much of the visits of the Inspectors may thus be turned to great advantage. The lecturers on co-operation could have answered the purpose to the point of perfection but for their removal.

To grapple with the present problem, a picture of the existing state of affairs in a rural co-operative society must be formed. The main idea of the great majority of the members is that the society is organised only to furnish them with money at a moment's notice. There is hardly a single member in each society who has grasped the idea of co-operation and the aims of the society. The stumbling block in the general improvement of people is their utter apathy to what is going on around them. How many members are there in each society who have taken the trouble to ascertain the share capital

of the society or the number of members on the roll? A humorous incident is told of how an officer, while motoring past a village stopped before a co-operative society and while casually inspecting the books of the society happened to ask a member standing by whether he had studied anything about the co-operative movement, limited and unlimited societies, and such like things. The man is said to have replied, "Sir, I know nothing of all that. They made me the President and there is an end of it." Asked whether he knew anything about the financial state of his society, he replied that there was the Secretary to look after all such things, who, he said, was paid every year to do so. (The payment was an honorarium).

It must be brought home to every member of a society that a co-operative society is not a Government institution, but that it is a private concern where each has the welfare of the whole community as his sole responsibility, where private interests are smothered for the good of a neighbour, where each member throws off his individuality as he would a cloak and becomes merged in the general and congregational duties as an equal with the rest; where external interference, not advice, is resented in a body and where official arrogance meets with the haughty coldness which it deserves. Great effort must be made to make it evident to these people that these rural societies in particular are not meant to be money making machines, nor that they are only financing agencies. The manifold purposes that a society ought to serve must be well impressed on the individual member, how it can be of help to them financially, commercially, industrially, educationally, mentally and morally. Each society as a body must patronise its own local industries and commerce. For this purpose a portion of the net proceeds of the society can be set apart by each co-operative society not by official interference from without, but by the voluntary gift of the society which can be effected by persuasion if necessary. The attraction of deposits and the collection of such deposits is a necessary function of a co-operative society and is a sign of a great confidence in the society, besides being convenient working material for the society.

Lastly, all egotism must be effaced. With its disappearance party spirit, that bane of rural advancement, vanishes. Each member should be brought to understand that he is the party who is honoured by admission into the society, and not the society which is the gainer. It gives to the humblest a feeling of equality with the highest and to the social magnates of the locality a satisfaction of having really stretched forth a hand of help to a trodden neighbour. Public spirit is thus inculcated into the mind of the villager who really possesses more common sense than he is commonly credited with.

These ideas can be achieved only by lecturing at the doors of the villagers with practical illustrations, and drawing comparisons with parallels obtaining from the Western countries. The ideas thus sown by these lectures may or may not take effect. As in the famous parable of the New Testament some of the seeds may fall up on rocky soil and perish, some might fall among thorns and bush and get eaten up by birds and be otherwise useless, while some at least might fall on good soil and take root and bear fruit.

GENERAL.

LAWN-MAKING IN THE TROPICS.

[*Illustrated.—See frontispiece.*]

The question of lawn-making in the tropics is one that concerns, or should concern, almost every person possessing a bungalow, for a piece of lawn, however small, is an important if not indispensable adjunct of every place of residence. It has been well said that "a good lawn to a garden is what a background is to a picture." One might say that a good lawn is even the most important feature of the garden picture. Nothing is more refreshing than an expanse of smooth green sward; it has a special and distinctive charm, enhances the beauty of surrounding objects, whether they be trees, shrubs, or flower beds, and forms a most pleasing adornment to a bungalow or dwelling. Many people think it is almost impossible to make a good lawn in the tropics, which by no means is the case, though admittedly it is not as simple a problem as in temperate countries. The chief trouble is, as a rule, in the upkeep, not in the initial making; but unfortunately no means have yet been devised of maintaining a good lawn except by constant attention to mowing, also to rolling and watering as may be required. The chief reason that lawns are not more generally seen in Ceylon is that people do not realise their incomparable charm, preferring to devote their energies, often with futile results, to growing some tender exotic flowering plants. This lack of appreciation is especially noticeable at railway stations, rest-houses, etc., where great efforts are sometimes made to carry out fantastic designs in pebbles or some dwarf unattractive plant, dissected by miniature paths which are often only wide enough for a cat to walk on.

PREPARING THE GROUND.

In some cases, as in ordinary pasture land, it may be only necessary to uproot weeds and coarse growth, fill up depressions in the surface, and close-cut the grass or herbage regularly in order to obtain a tolerably good lawn. But under less favoured conditions, as in the case of uncultivated or unreclaimed land, it is essential at the outset that the ground be properly prepared, the surface thoroughly dug to a depth of about ten inches and uniformly levelled—large stones, roots and similar obstacles being removed and the surface raked level. If the sub-soil be heavy or clayey, and the position low and flat, provision must be made for proper drainage and for the escape of excessive rainwater; but if the land be undulated or the soil of a loose gravelly nature, artificial drainage should not be necessary, at least once the ground is well set and covered with turf. In the case of newly-made soil, however, especially if on a slope, it may be necessary to make slanting drains of gentle gradient at suitable intervals, according to situation, so as to prevent washaway by heavy rainfalls. As the surface becomes consolidated and well-bound by the turf, these drains may be gradually closed up. If the soil is very poor, it is liable to result in the turf being thin and patchy especially in dry weather; therefore it is advisable to place on top a layer of good soil, or preferably a compost of soil and well decomposed manure. In case where there is nothing but sand, clay, or laterite (a not very rare occurrence in the tropics), it is necessary of course to transport soil from the nearest source available. This should be laid on to a depth of at least two

Photos by H. F. Macmillan.

The top photograph shows a large mower in use on the Great Circle lawn in the Royal Botanic Gardens, Peradeniya; the lower shows a "Bent-cutter" at work on rough ground, also in the Gardens.

or three inches, forking it in roughly with the foundation in order to enable it to grip the latter, finishing off with a thin layer of soil on the top, after which the surface should be finely raked. In order to ensure a uniformly even surface, pegs should be driven into the ground at the extreme points, and intermediate pegs at regular distances between these; the desired level or gradient from peg to peg can easily be obtained by means of a spirit-level and a long piece of wood having a straight edge. At least a portion of the lawn should be level, so as to allow of sitting out and of games being played if desired; but it should not be forgotten that natural undulations and sloping banks have a very pleasing effect, and these should be worked in whenever possible. It is essential that the surface should be as uniformly even as possible, for otherwise the mowing machine will be unable to cut the grass in the depressions, and the general result will be unsatisfactory. Sloping banks should not be so steep as to make it difficult to cut the grass and keep the turf in good order, a gradient of more than one in two being excessive. Finally, it should be remembered that faults in general are easier to correct while the lawn is being made than afterwards.

TURFING.

The quickest and, at any rate for the low-country, the most satisfactory method of forming a lawn is to lay turf by hand, sowing seed being generally slow and precarious under the best of circumstances. The sods should be obtained from close-grazed pasture land, and cut as nearly as possible to uniform thickness. This is best done by a spade, though for ordinary purposes a mammoty will answer, and this is the easiest tool for coolies to handle. It is important that the turfs should be laid as fresh as possible, the earth being scooped out with a trowel so as to make a bed for each, afterwards pressing it in between them and filling up all crevices, finally sprinkling some fine soil on the surface. The sods being beaten down into position by means of a spade or a flat wooden beater, the whole surface should be thoroughly rolled over and afterwards watered. If the weather be wet, no further attention is necessary until the turf is well established, but if dry, watering must be done daily. A thin layer of any litter of leaves or grass which may be at hand if spread over the surface may save watering and hasten the turf in becoming established. A good plan is to drive a number of pegs, made of split bamboo or any other material convenient, into the turf a few inches apart, leaving about eight inches of these out of the ground. This has the effect not only of fixing the turf firmly in position until it has taken root, but also of keeping animals from trampling the surface. As soon as the turf has taken root, the pegs may be removed. On sloping banks this precaution is especially necessary.

TURF-GRAFTING.

Often, however, especially in the case of a large area, turfing becomes a laborious and costly undertaking. This may be obviated by what may be termed turf-grafting, i.e., laying the sods, or portions of these, a foot or more apart, sinking them level with the surface and fixing them with small pegs as described above. The intervening spaces may be sown with seed, or grass roots may be dibbled in, the whole surface being then rolled and watered. Though this method is suited to a flat surface, it may not always be adapted to steep banks, as in this case the loose earth between the sods is liable to be ferretted out by the rain.

DIBBLING GRASS-ROOTS.

As an alternative to the foregoing methods an even more economical plan may be adopted, that is by planting grass roots which may be obtained from any good turf or close-grazed pasture in the vicinity. The ground must

be prepared as already described, the surface in this case being brought to a fine tilth, thus enabling the grass roots to be dibbled in easily and firmly pressed down. Care should be taken that the roots are of the desired kind only; they should be planted about 3 inches apart, followed by a liberal watering and then slightly rolled. Wet seasons should, as of course in all planting operations, be chosen for the purpose; but if the weather should unexpectedly turn dry, watering and shading as above described become necessary. A special advantage of this method is that the desired species of grass may be chosen, undesirable kinds and weeds being easily eliminated.

APPLYING GRASS-ROOTS IN PASTE FORM.

A method favoured in Northern India is to pull up a quantity of grass (the Doob grass, *Cynodon dactylon*, being usually selected for the purpose) by the roots, chopping this up tolerably fine and mixing it with cowdung, mud. and sand, making a mixture of the consistency of mortar; this paste is spread thinly over the prepared ground, and in a short space of time a green and even cover is produced. This, however, would not be suited to a wet climate, where a single heavy shower might wash the whole preparation away.

LAWNS BY SEED-SOWING.

Lawn making by sowing seed is not generally satisfactory in the tropics, especially in the low-country. At the higher elevations, however, where certain English lawn-grasses will thrive for a time, it may be moderately successful, but even here it is difficult to prevent foreign or fine grasses from being rapidly superseded by coarse species and weeds. As, however, it is a question frequently asked, I may mention that suitable grass mixtures may be obtained from seed-merchants in England or Australia, the quantity usually required being about 50 lb. per acre, or $\frac{1}{2}$ to $\frac{3}{4}$ lb. per 30 square yards. Some recommend a more liberal allowance, say about 80 lb. to the acre, or 1 lb. to every 50 square yards. The ground should be well prepared and the surface brought to a fine pulverised state by raking, the seed when sown being raked in the usual way, followed by rolling, also by watering if the weather be dry. In the low-country a uniform green sward can seldom be obtained by sowing seed, owing to various reasons—the rapid growth of weeds, prevalence of bird and insect pests, and the liability of the seed to be washed away by heavy rain, or be exposed to a period of drought after sowing. Whatever method of lawn-making be adopted, whether seed-sowing, root-planting, or turf-grafting, an important poirt is that the margins should always be defined by laying a continuous belt of turf, even if it be but a foot in width.

LAWNS FOR GAMES.

Generally speaking, all that is expected of an ordinary lawn is that it should be uniformly smooth and green, and free from weeds. For purposes of games, however, such as croquet, putting-greens, etc., the conditions are more exacting. The surface must either be quite level or uniformly even, according to requirements; the grass forming the turf should be of the right kind, i.e. it should be a species with fine narrow leaves, a grass with broad, wiry or stiff leaves being unsuitable. It should preferably be a deep rather than a surface-rolling grass. The surface soil should be of an absorbent texture in order to enable rain to percolate through. If it is of a clayey adhesive nature a layer of a porous material, as coal ashes or broken brick and lime rubble, should be placed under the surface; otherwise constant trouble is likely to be experienced from worm castings, patchiness, and sloppy surface in wet weather. Frequent rolling is necessary, but it should not be carried out when the ground is very wet. Small depressions may be filled up by sprinkling a mixture of finely sifted soil and sand over the surface, drawing

Photos by H. F. Macmillan.

NEW RECREATION GROUND, TRINITY COLLEGE, KANDY.
The Turf is composed entirely of the Doob-grass *(Cynodon dactylon)*. The top photograph shows an early stage and boys dibbling the grass roots; the lower shows the lawn well covered, with boys picking out weeds or extraneous grasses.

it along with the back of a rake or a flat straight board. It is of primary importance that a supply of water be close at hand. To be properly equipped, water should be laid on in pipes and controlled by sunk taps or hydrants, to which a hose may be attached.

MOWERS.

The question is often asked: What are the most suitable lawn mowers for the tropics? It may be stated at once that well-made English machines of such well-known makes as RANSOME'S, SHANKS'S, GREEN'S, etc., will meet one's requirements in the tropics as elsewhere, provided the lawn is not allowed to run into a state of neglect. Owing, however, to the rapid rate of growth generally characteristic of the tropics, the tendency of coarse or arborescent growths rapidly superseding tender grasses, and the prevalence of termites and other ground pests, it is not always practicable to keep the turf in a condition fit for ordinary small mowers. Moreover, in a large garden or park there are parts in which it is desired only to keep down the rough grass or herbage, and how to deal with this satisfactorily is often a problem. In Peradeniya Gardens, where the larger lawns cover several acres in extent, a reaper machine with low-set knives, and adapted to bullock draught, is found very serviceable. It has a cutting width of 48 inches, is easily worked, and being drawn by two bulls, can be used in any weather. A very useful machine recently introduced is what is called RANSOME'S Bent-cutter. It is light and simple, easily repaired, and has a cutting width of 24 inches. Fitted on rather high wheels, with a good clearance, the four spirally placed knives revolve at a rapid pace and are reversible. It is specially adapted for golf links or situations where it is desired to cut chiefly the bent or pasture flower-heads. To a cooly a bamboo splint with a sharp edge, and shaped like a long sword, is a welcome substitute for a mowing machine. On steep banks this is a fairly efficient implement, especially where the turf has good recuperative powers.

UPKEEP OF LAWNS.

The success of a lawn depends entirely upon its proper up-keep; it should as far as practicable be kept free of weeds, mowed at brief intervals with a mowing machine, and never allowed to produce seed stalks or wear a neglected appearance. Frequent cutting, which is analogous to pruning, is most beneficial and results in close springy sward which gives a delightful feeling of elasticity. A heavy roller should be used frequently, but not when the ground is either very wet or unusually dry. A mower should not be employed until a firm green sward has been formed, the grass at first being cut by a scythe or sickle, so as to encourage the plants to tiller. When lawns become impoverished, a top dressing of a rich compost consisting of fine loamy soil, well rotted manure, and some fine river sand should be given, this being raked well in and the surface afterwards rolled and watered. The dressing should not be sufficient to completely hide the grass from view. The above application may with advantage be supplemented by some suitable chemical manure, say, at the rate of about 5 or 6 lb. per 40 square yards, according to ingredients, this being well mixed with the above compost before application. Nitrate of soda is an excellent stimulant and may be applied at the rate of about one pound per 40 square yards. Ammonium sulphate is, however, considered by some to be preferable, it being claimed for it, if applied in a liberal manner (say 1½ lb. dissolved in 4 gallons of water to 100 square feet of surface), to have the effect of eliminating coarse weeds while benefiting the grass. It should be remembered that nitrogenous manures encourage the growth of grasses and depress clovers, while potash manures encourage clovers. A sprinkling of fine river sand (not coarse gravelly sand), especially if mixed in equal proportions with finely sifted loamy soil, has a very beneficial effect on lawns; it acts as a mulch and renders the soil more absorbent to rain, producing a soft and even surface.

ENEMIES OF LAWNS.

Perhaps the most formidable of these in the low-country is the pernicious termite or white-ant, whose "nests" should be looked for and destroyed at the earliest signs, either by digging them out, or, if discovered in their early stages, by pouring a small quantity of carbon bisulphide or pumping poisonous fumes down their crevices. The device known as the "ant-exterminator" is excellent for destroying ants in large nests, but is hardly practicable for use on lawns, except in the case of ant-nests which have been allowed to grow to a large size. At the higher elevations lawns are apt to deteriorate from a persistent growth of moss. The remedy is to improve the drainage and, after eradicating the moss by means of an iron-toothed rake, give a top-dressing of a mixture as already described, to which may be added some freshly slaked lime. An application of basic slag (1 lb. per square rod) has also a good effect. Certain weeds are particularly partial to lawns, one of the worst being the "Elephant's foot" (*Elephantopus scaber*). These should be dug up by a spud or "daisy fork;" or the plants may be killed by dropping poison into their centre. Worm-casts in lawns are particularly objectionable, and are generally due to imperfect draining or an excess of vegetable matter in the soil. Ground that is worked deep and is of an open, percolative nature seldom exhibits worm castings. Watering the soil with Vaporite, or a weak solution of ammonia or lime water, will cause the worms to come to the surface, when they should be collected and destroyed. "Fairy rings" are not so common in the tropics as in temperate countries, where they often do considerable damage to lawns. They are due to a puff-ball fungus, and the best remedy has been found to be a solution of iron sulphate, 8 lb. in 30 gallons of water, using half a gallon to a square yard.

SUITABLE GRASSES FOR LAWNS.

As to what constitutes the best grasses for lawns, much depends on climate and local conditions. Those which are suitable in the low-country will not thrive at the higher elevations, and vice versa. Certain species are peculiarly suited to dry regions, of which the "Doob-grass" (*Cynodon dactylon*) is an example. This is a favourite for the dry plains of India, occurs naturally practically all over Ceylon, and is often the first grass to take possession of newly made ground; but in wet districts, unfortunately, it is soon superseded by coarser growing kinds, unless these are constantly watched for and eradicated. The love-grass or "Tutteri" forms excellent turf in the moist low-country in spite of the objection to it, when allowed to flower and seed, owing to its sharp hooked awns which adhere to and penetrate one's clothes. It is deep-rooted and stands drought well. The Couch-grass (*Panicum repens*), a persistent weed in some up-country districts, is probably the best grass for lawns at the higher elevations, being deep-rooted and consequently drought-resistant. MR. N. G. CAMPBELL found it the best grass for putting-greens on the Nuwara Eliya famous golf links. It is important that a lawn grass should be deep-rather than surface-rooted, and of a spreading creeping habit. Grasses with broad or wiry leaves, as has already been pointed out, or which are inclined to a tufty habit, are unsuitable for the purpose. The ordinary self-formed turf on the lawns in Peradeniya Gardens has been found to consist chiefly of the following species:—*Chrysopogon aciculatus* (Love-grass" or "Tutteri,") *Ischaemum ciliare* ("Rattana,") *Setaria glauca* ("Kavulu"), *Anthestiria tremula*, *Panicum sanguinale*, *Sporobulus diander*, and the clover-like *Desmodium triflorum* ("Hin-undupiyali"). Under the shade of trees the principal turf-grasses are *Paspalum undulatum*, *Paspalum conjugatum*, *Panicum trigonum*, *Oplismenus compositus* and *Apluda aristata*.

H. F. MACMILLAN.

Photos by H. F. Macmillan.

PUTTING-GREEN ON PERADENIYA GOLF LINKS.

Showing commencement and finish. The turf is composed almost entirely of the love-grass, *Chrysopogon aciculatus*.

THE CEYLON AGRICULTURAL SOCIETY.

PROGRESS REPORT LXVIII.

PADDY (RICE).

Change of Seed.—In March last 1½ bushels of *Heenati* Paddy were sent to a member in Ambalantota. MR. KARUNANAYAKE, Instructor, reports that this quantity gave a return of 30 bushels, while the average yield in the neighbourhood is only 10 fold or 10 times the quantity sown. The crop took 4 months to ripen. In Kandy, whence the paddy was sent, *Heenati* takes 4½ months from sowing to harvest.

In August a bushel of *Hondrawala* Paddy, also from Kandy, was supplied to a member at Marawila.

In September a bushel of *Heenati* was sent to the Mudaliyar of Hinidum Pattu to grow by way of experiment. It was reported that owing to the destruction of crops by flood, cultivators were very short of seed paddy, but they were reluctant to use seed from another district. The Mudaliyar hopes that his experiment will be successful and help to remove this prejudice.

Transplanting.—This season several transplanting experiments are being carried on. In Madampe district, for the first time, a field has been planted with seedlings raised in a nursery. The experiment is carried out under MR. MOLEGODE'S supervision at the request of MR. GRAHAM PANDITHESEKERA, and is being followed with interest.

At the Training Colony at Peradeniya a part of the paddy field has been planted by the students themselves with *Molagu Samba* seedlings, single seedlings being put 4 inches apart; the rest is being planted with 3 seedlings 4 inches apart.

At the request of MR. R. SENIOR-WHITE of Suduganga Estate a nursery of *Molagu Samba* Paddy was established on the 13th of October and transplanted about the middle of November, single seedlings being put 4 inches apart.

The Society is co-operating with MR. A. B. THOMSON of Marakona Estate, Ukuwela, in a trial of paddy cultivation by transplanting. The variety grown is Hondarawala and the seedlings are being planted out 6 inches by 6.

In Haris Pattu, where for the last 5 years a series of successful demonstrations have been made, the Instructors still continue to go amongst the cultivators with a view to induce them to plant no more than 3 plants per hole instead of bunches of 6 or more plants together, as they are inclined to do.

Water-Resisting Paddy.—MR. D. A. GOONAWARDENA of Baddegama tried a further experiment in the cultivation of *Burmese water-resisting* paddy during the last Yala Crop and the results are as follows :—

Plot No. 1.—Very low land. Sown broadcast on 1st April, was under water from 2nd to 12th May, 7th to 17th, 24th to 26th June and 13th to 31st July. Crop withstood inundation well but unfortunately the last flood occurred when the paddy was flowering and consequently the grain was damaged.

Plot No. 2.—Slightly higher than Plot No. 1. Seed broadcasted 10th April, was under water from 6th to 12th May, 12th to 18th June, 14th to 20th July. The crop withstood inundation well but yielded only at the rate of 12 bushels per acre. Harvested 2nd September.

Plot No. 3.—Broadcasted 3rd April, was under water 7th to 11th May 13th to 17th June and 13th to 19th July. Here too the inundation occurred during the flowering stage and spoilt the crop.

FRUIT CULTIVATION.

A small lot of Sapodillas grafted on *Bassia Longifolia* were recently distributed by the Society.

The HON'BLE SIR CHRISTOFFEL OBEYESEKERE has succeeded in growing an excellent apple (to judge from a sample forwarded to Peradeniya) at Wilson's Bungalow, Palugama, at an elevation of about 3,500 feet above sea level and with an average rainfall of about 60 inches. Writing on the subject, SIR CHRISTOFFEL says that he has two fruiting trees of which the plants were obtained from Hakgala some 8 years ago.

DR. DAVID FAIRCHILD, Agricultural Explorer, U.S.A. Department of Agriculture, who has visited Ceylon on more than one occasion, contributes an interesting paper on the Mangosteen to the JOURNAL OF HEREDITY for August last. In it he refers to the experience of the late MR. W. H. WRIGHT and MR. F. L. DANIEL, both of whom made a careful study of the conditions under which the Mangosteen grows best.

DR. FAIRCHILD states that MR. G. S. OLIVER, also of the U.S.A. Department of Agriculture, has succeeded in grafting the Mangosteen on 20 other species of Garcinia, the most promising stocks being *G. tinctoria*, *G. morella* and *G. Livistononei*. At the Government Stock Garden inarching on *G. xanthochymus* has been successfully carried out.

A fair number of local Persimmon trees have borne fruit this year. The fruit is botanically known as *Diospyros kaki* and sometimes called Kaki fruit or date-plum. MACMILLAN describes the tree as medium sized and slow-growing with large handsome ovate or cordate leaves. The fruit in appearance suggests an orange-yellow tomato, but the flavour is not unlike that of the Sapodilla. It dries well and is exported from Japan in that form. In that country the varieties are said to number about a hundred and these are classified as sweet and astringent. The tree is usually diœcious, i.e., bearing male and female flowers on different trees. The Society is arranging to import some plants from Japan, but it may be stated that, like the Cherimoyer, the tree thrives at an elevation of 4 to 5,000 feet and does not do in the low-country.

INVESTIGATIONS.

PROFESSOR DUNSTAN, in a letter to HIS EXCELLENCY THE GOVERNOR under date 24th June 1915, wrote : "I have the honour to enclose a report on the results of the examination of the leaves of *Adhatoda vasica*, a sample of which was forwarded to the Imperial Institute by the Secretary of the Ceylon Agricultural Society with letter dated 22nd June, 1910.

"The reputed poisonous properties of this plant were mentioned to me during a visit to Ceylon by MR. DRIEBERG, and I then suggested that the plant should be examined at the Imperial Institute with special reference to the possible occurrence of a volatile alkaloid.

"These leaves are used in Indian native medicine as an expectorant, and were reported to contain an alkaloid (vasicine) which had, however, never been properly examined. A quantity of the alkaloid has been isolated from the leaves at the Imperial Institute, and is now under detailed chemical examination. Physiological trials of the alkaloid have also been carried out by PROFESSOR A. R. CUSHNY, F.R.S., of the University College, London, but, unfortunately the results indicate that the substance has no therapeutic value. It is, however, desirable that the chemical examination of this alkaloid should be completed, and for this purpose I have already asked the Secretary of the Ceylon Agricultural Society for a further supply of the leaves."

The following is the interim report :—"The leaves of *Adhatoda vasica* (which are the subject of this report) were received from the Secretary of the Ceylon Agricultural Society with letter No. 1570, dated 22nd June, 1910.

These leaves were forwarded at the request of the Director of the Imperial Institute in order that certain properties attributed to them in Ceylon might be investigated, as it seemed likely that these properties might be due to the presence of a volatile alkaloid. The leaves are used in India as an expectorant, and a previous investigation by HOOPER had shown that they contain an alkaloid, which, however, was not fully characterised.

"The sample weighed 9 lb. and consisted of broken leaves which appeared to have ranged from about 5 to 8 inches in length and were sage-green on the upper surface and yellowish-brown green underneath. The leaves possessed no appreciable smell, but had a somewhat bitter taste.

"The leaves as received at the Imperial Institute contained no volatile alkaloid. They were, however, found to contain 0·46 per cent. of a non-volatile alkaloid, equivalent to 0·50 per cent. in the dry leaves. The pure alkaloid was obtained as a white granular substance, which when viewed under the microscope was seen to consist of masses of slender needles. The alkaloid is sparingly soluble in water, and the solution has a distinct alkaline reaction to litmus. After drying at 100° C the alkaloid melts indefinitely between 150° C and 155° C. The hydrochloride, hydrobromide, nitrate and aurichloride of the alkaloid were obtained in a crystalline condition.

"The alkaloid (vasicine) isolated by HOOPER from the leaves was stated to be poisonous to the lower orders of animals, but not to the higher animals, and it seemed probable that it was the active constituent of the drug. Arrangements were accordingly made to have physiological trials conducted with the alkaloid isolated at the Imperial Institute, and this work was kindly undertaken by PROFESSOR A. R. CUSHNY, F.R.S., of the University College, London, who was supplied with a quantity of the crystalline hydrobromide of the alkaloid. PROFESSOR CUSHNY reports as follows on the results of his experiments :—

"(1) When injected into a frog, in the proportion of 0·9 gram per kilogram of body weight, the hydrobromide caused some clumsiness and incoördination in movement, but the animal continued active and recovered in 2 to 3 hours.

"(2) In rats, 0·4 gram per kilogram of body weight injected hypodermically caused some dyspnœa and cyanosis, with lessened movement and weakness, but these symptoms disappeared in two hours and the animal remained normal thereafter.

"(3) In cats, 0·025 gram per kilogram injected hypodermically had no apparent effect, and 0·05 gram per kilogram given by the mouth was equally ineffective.

"(4) In man, 20 mgs. administered by the mouth had no apparent action, apart from the slightly bitter taste.

"(5) Protozoa such as Paramœcium and Colpidium continued to move about in a 1 per cent. solution of the hydrobromide for 30 minutes or longer.

"The doses given in each of the foregoing instances were very large, and the results indicate that the alkaloid yielded by the leaves of *Adhatoda vasica* is of no therapeutic value.

"It is impossible to say definitely whether the alkaloid obtained in the course of this investigation is identical with the vasicine isolated by HOOPER. The present alkaloid does not give the colour change on fusion described by HOOPER for vasicine, and such slight physiological action as it exhibits appears to be different.

"The investigation of the leaves is being continued, as it will be of interest to complete the chemical examination even if the material proves to have no therapeutic value."

A further consignment of leaves is going forward.

It should be added that the leaves when used on irrigated paddy fields has been found to prevent the growth of low-life flora and also act as an insecticide. It was this fact, and not to any specific poisonous effect on the higher fauna that was brought to the notice of PROFESSOR DUNSTAN.

The dried leaves of adhatoda are reputed to relieve asthmatic patients when smoked in the form of a cigarette, and are commonly offered for sale as such.

At the instance of MR. J. P. OBEYSEKERE, who suggested that an analysis of average samples of Ceylon paddy grown in the low-country and on the hills should be procured in order to ascertain what proportions of organic and mineral ingredient were taken out of the soil, the Government Agricultural Chemist made the following report on the material furnished to him :—

"(1) Hill paddy.—a. *Food Analysis.*—Moisture 9·0 %, Oil 2·4 %, Ash 4·7 %, Woody fibre 9·5 %, Proteids 9·0 %, Carbohydride 65·4 %, total 100·0 %; Nitrogen 1·44 %, Nutritive ratio 1 : 8.

"b. *Ash Analysis.*—Moisture 9·00 %, Organic matter 86·26 %, Ash 4·74 %, total 100·00 %, Lime 1·6 %, Magnesia 3·3 %, Potash 4·9 %, Phosphoric acid 9·0 %, Silica 74·5 %, Sulphuric anhydride 0·7 %, Chlorine trace, Soda 4·6 %, Iron and Alumina 1·4 %, total 100·00 %.

"2. Lowland paddy.—a. *Food Analysis.*—Moisture 6·9 %, Oil 1·7 %, Ash 5·5 %, Woody fibre 11·0 %, Proteids 7·6 %, Carbohydride 67·3 %, total 100·0 %; Nitrogen 1·22 %, Nutritive ratio 1 : 9·4.

b. *Ash Analysis.*—Moisture 6·90 %, Organic matter 87·56 %, Ash 5·54 %, total 100·00 %. Lime 1·20 %, Magnesia 3·46 %, Potash 4·35 %, Phosphoric acid 8·96 %, Silica 77·44 %, Sulphuric anhydride 0·34 %, Chlorine trace, Soda 2·30 %, Iron and Alumina 1·95 %, total 100·00 %."

MR H. L. VAN BUUREN applied for seeds of the variety of *Paspalum scrobiculatum*, commonly known as "Mat-amu" reported to possess poisonous properties, with a view to his investigating the poisonous agency, which it had been suggested to him by the Government Mycologist might be traceable to a phosphorescent fungus analogous to that occurring on species of *Lolium* grass in Europe. Seed obtained through MR. S. D. MAHAWALATENNE (late R. M.) of Balangoda are being grown at the Government Stock Garden under MR. VAN BUUREN's observation.

PESTS AND DISEASES.

The Assistant Entomologist reported as follows on a caterpillar attacking Agathi plants (*Sesbania grandiflora*):—

"The caterpillars sent are larvæ of a pierid butterfly. They cannot be certainly identified until the imago has been reared, which will probably take another fortnight.

"The pest could be easily controlled by spraying affected trees with arsenate of lead, but as this substance is poisonous there would be danger in using it on leaves of trees used for curry, etc.

"'Vermisapon' which can be obtained from MESSRS. E. B. CREASY & Co., Colombo, may be sprayed on, and is likely to be effective while the caterpillars are small. This substance is non-poisonous."

Later he added :—

"The caterpillars defoliating *Sesbania grandiflora* have been bred out and prove to be the common yellow and black butterfly, *Terias hecabe*, which also defoliates Albizzias."

On specimens of beetles found as a pest in Marawila District the Assistant Entomologist reported :—"The Beetle is the well-known Cockchafer, *Lepidiota pinguis*. The immature stage of the beetle is a large white grub which lives underground and does much damage to roots of various plants.

"I am supplying the live specimen with various plants to discover its food-plant, and I am also trying it with coconut leaves of different stages of growth. Probably the best means of dealing with this pest is with beetle traps composed of fresh cow-dung and any rotting vegetation, mixed together and placed in prepared holes in the ground. The female beetles visit these places and lay their eggs in them. When the mass of rubbish has been lying about three months it should be turned out and any beetles or grubs seen should be killed. The rubbish can then be returned to the hole and examined again in another three months' time. If these beetle-traps are distributed fairly numerously (say one to an acre), they should gradually lead to the eradication of all Cockchafer pests and also the black Coconut Beetle, *Oryctes rhinoceros*, which prefers laying its eggs in such places."

Specimens of diseased cinnamon were received from Seeduwa with the following note :—"The leaves are first affected and thence the disease appears to travel down the bark of the stem till it reaches the root, the branches withering at the same time. In some areas fully half the number of bushes are affected. Even when the leaves only are affected the bark is found to be unpeelable."

The Assistant Botanist and Mycologist reported on the specimens :—"The leaves are attacked by a *Gloeosporium* and a *Colletotrichum*. A second symptom present may be due to *Pestalozzia* (Grey Blight), but no specimens could be obtained. The leaf disease is of minor importance. The stems are attacked by 'red rust' (*Cephaleuros mycoidea*) which is the cause of the damage."

Mango leaves attacked by a caterpillar were submitted by MR. MOLEGODE to the Assistant Entomologist, who identified the pest as the grub of a moth (*Thalassodes Quadraria*) and suggested that the trees should be sprayed with arsenate of lead.

DR. MUTTUKUMARU of Bandarawela forwarded specimens of an insect attacking the blossoms of introduced varieties of mangoes and preventing the setting of fruit. The specimens were submitted to the Assistant Entomologist who reported as follows :—

"The insects attacking Mango flowers are a species of *Chrysomelid* beetles. I have no named specimens of this species, and am unable to identify them with certainty. Spraying the trees with arsenate of lead should be a means of getting rid of them. As they probably attack only the flowers and young buds these only would have to be treated. A simple method of reducing their numbers would be to send round a couple of boys, one to disturb the flower-bunches and the other to catch the beetles in a long-handled butterfly-net as they fall. An alternative method is for the second boy to hold a pan of water, with a film of kerosene on the surface, under the flowers so as to catch the falling beetles, but neither of these plans is practicable if the trees are very high or the flower-bunches are out of reach. On the whole, the spraying method is likely to prove the most successful."

Damaged Brinjal plants submitted to the Assistant Entomologist were found to be attacked by the "Shoot Borer" caterpillar. The treatment recommended is to cut off each affected plant below the point of attack (which can be detected by a discolouration at the spot) and burning all the cuttings. The resulting moths may be captured and destroyed with the aid of light traps.

The Mudaliyar, Pitigal Korale South, reported the occurrence of an insect pest which feeds on the leaves of the coconut palm.

The Assistant Government Entomologist is visiting the affected area with a view to studying the pest.

On specimens of damaged Knol-kohl, the same officer reports :—

"The trouble is apparently caused by brown ants (most probably *Dorylus orientalis*), which attack and eat many garden plants and vegetables. The presence of the white ant is doubtless due to the use of the cow-dung manure, and is a sign that the former was not sufficiently rotted ; as they will not attack really old manure after fungal growth has ceased in it (i.e., when decomposition has proceeded as far as it will go). Probably the white ants were first attracted by the manure and then the *Dorylus* ants were attracted by the presence of the white ants, subsequently transferring their attention to the Knol-kohl. "Vaporite" should be dibbled into the ground near the plants or mixed with the soil some days before putting the plants down. It should not, however, touch the roots."

On a specimen of insect-damaged brinjal at Anuradhapura, forwarded by MR. MADANAYAKE, Agricultural Instructor, the Government Entomologist reported :—"The insect is *Leucinodes orbonalis*, which bores into young shoots of brinjals in India and Ceylon. The affected shoots and fruits should be collected and destroyed."

CINNAMON BARK OIL.

In June last the Director of the Imperial Institute wrote :—

"I understand that before the war a considerable quantity of cinnamon bark oil was distilled in Ceylon and exported to France and Germany, whence part of it was re-exported to this country.

"Importers in this country are now desirous of getting into direct touch with Ceylon producers of cinnamon bark oil, and I shall be much obliged if you will let me have the names and addresses of such firms, with any information that may be available as to the price at which the oil could be offered and the quantities available for shipment.

"For certain purposes it is essential that importers should be in a position to guarantee that this oil is genuine, i.e. that it consists only of oil distilled from cinnamon bark and contains no added cinnamic aldehyde, cassia oil or other adulterants. I realise that it may be difficult to obtain trustworthy information on this point, but I shall be much obliged if you will make enquiries and let me know whether I could assure the British Firms interested that they can regard the oil as genuine. MR. BRUCE may be able to give you assistance and information on this part of the subject.

"I shall also be glad to have a typical sample of about 1 lb. of the oil."

On consulting the Secretary, Lowcountry Products Association, that officer reported :—"The distillation of Cinnamon Bark oil was practically abandoned some years ago owing to a drop in the price offered for it and the greater demand for the Leaf Oil. It is not likely that a trade involving the setting up of stills for distillation can be restored afresh unless there is a very strong demand for pure Bark Oil, and, at the same time, the market for Cinnamon Chips from which it is distilled shrinks considerably. I realise, however, that the enquiry from the Imperial Institute deserves the closest attention of the proprietors of Cinnamon Estates, and shall endeavour to arrange for a conference with them and inform you definitely whether it is possible to revive the industry. I may add that if the Bark Oil is distilled it will be pure."

MESSRS. CHAS. P. HAYLEY & Co. wrote :—

"At the approximate price of Re. 1/25 to Re. 1/50 per oz. leaf oil is undoubtedly mixed with the bark oil, but at about Rs. 3/ to Rs. 3/50 a pure distillate can be obtained."

MUDALIYAR A. E. RAJAPAKSE furnished the following information:—"Unadulterated Cinnamon Bark Oil is not exported from the Island owing to its high cost and the absence of a satisfactory market. The oil which is being exported from Ceylon and passed off as bark-oil generally contains 50 per cent. or more of cinnamon leaf oil. If any pure Bark Oil has been recently exported to England from Germany it must have been oil distilled in Germany from Chips. If there are buyers at Rs. 3/- an ounce I am prepared to take it up and distil the oil myself and give a guarantee as to its purity."

MR. BRUCE wrote:—"The market for this product is very poor at present. The product is rarely pure, containing from 10 to 20 per cent. of leaf oil."

Subsequently the Secretary of the Lowcountry Products Association reported:—"I have now had the privilege of consulting those engaged in the Cinnamon industry, and I am prepared to supply any English consumers who desire to purchase Cinnamon Bark Oil about 1,000 ounces per month. The price F.O.B. in Ceylon will be about Rs. 2/25 or 3 shillings per ounce.

"As the Cinnamon industry is at a very low ebb it will be of particular benefit to small-holders if an order can be secured. I may mention that the previous price for this oil was 4 shillings."

A pound sample was specially distilled for the Society and submitted to the Government Agricultural Chemist, whose report on the same was as follows:—"Aldehyde 68 per cent.; Eugenol 16 per cent.; Rotation 1·0. I consider this a commercial sample and of fair purity although it is rather high in Eugenol."

POLLINATION OF CACAO.

The A. I. Root Company of Medina, Ohio, the leading apicultural firm in America, and therefore greatly interested in the work of the honey-bee as an agricultural ally, wrote under date July 6th:—"You are doubtless aware that the agency of the common honey bee is valuable in the pollination of the fruit of the temperate zone, e.g. apples, grapes, peaches and plums. The bees carry the pollen from one blossom to another, and from one tree to another. This results in a much larger yield than would be the case were the wind alone relied upon to perform the service.

"We write for information as to what part the bee plays, if any, in the pollination of tropical fruits, such as citrus, bananas, and cacao. We have considerable information in regard to other tropical fruits, but what we want to get at mostly is something in regard to the pollination of cacao. We should like to know if honey bees have ever been seen on the blossoms of cacao, or whether the fruit will mature and produce good seed in places where the honey bee is absent."

On consulting those likely to afford information on the point, the Assistant Entomologist wrote:—"I have not yet had opportunity of observing the part played by bees in the pollination of the Cacao blossom. I will take the first opportunity of watching this. Off-hand, however, I think it unlikely that they play any important part."

"Citrus and Banana flowers are pollinated by bees."

The Manager of the Experiment Station, Peradeniya, wrote regretting his inability to furnish any data, but said he would watch and see, though he was of opinion that bees did not take much part. In his opinion the pollinating agents were more likely to be ants and small winged insects.

DR. UZEL'S observation at Peradeniya led him to the conclusion that pollination in cacao was affected solely by Thrips, which were most in evidence on the flowers.

E. E. GREEN recorded the occurrence of no less than 30 specimens of the common Aphis (*Ceylonia theæccola*) on a single flower.

HART was of the view that pollination was due to several kinds of small insects. He disputed UZEL's statement, since in Trinidad there were few if any Thrips, which, therefore, cannot be said to be solely instrumental in pollinating cacao flowers.

HART dwelt on the fact that little trouble is experienced by any want of effective pollination, as fertilization is regularly effected in proportion to the flowers that appear.

INTRODUCTIONS.

Seed of a new variety of Dhall (*Cajanus indicus*) were procured through the courtesy of the Deputy Director of Agriculture, Northern Circle, India. The variety is from a selected line raised at the Government Experimental Farm, Poivar Khera. The chief characteristics of the new Dhall are a spreading bushy habit, a heavy yield, white pods and light coloured seed and a small sowing rate (2 seers per acre). The seed was distributed to Agricultural Instructors and School Gardens.

The Society is indebted to DR. DAVID FAIRCHILD, Agricultural Explorer, U S.A. Department of Agriculture, for seed of *Phaseolus acutifolius*, commonly known as the Tepary bean from Arizona. It is specially suited to dry areas as it germinates quickly in little soil moisture, and, once established, stands drought successfully. Tepary is reputed to give four times as large a crop as the ordinary Kidney bean. The seed was distributed in October for trial in the drier parts of the Island and reports as to its growth are being awaited.

In July last MR. C. CASSIPILLAI, who is always ready to try new methods of cultivation and new varieties of crops, wrote inviting attention to the reference to SAN RAMOAN coconuts on page 110 of COPELAND'S work on the coconut, where the author states that 3,270 nuts of this variety go to make a ton of copra, i.e. about 818 to the candy. This he pointed out as remarkable, and enquired if the Society could get him some seed nuts for planting.

By communication with the Agricultural Department it has been possible to procure 4 dozen nuts which have been despatched to MR. CASSIPILLAI, and were in good time for planting during the N. E. Monsoon rains. The nuts which are abnormally large were received in excellent condition, nearly all having germinated in transit.

This introduction is a notable one, particularly for the Jaffna peninsula, and thanks are due to MR. CASSIPILLAI for his enterprise.

DISTRIBUTION OF PLANTS AND SEEDS.

Mudaliyar A. NAGANATHER of Nuwara Eliya has offered to supply a quantity of the purple Jaffna "King Yam" (a variety of *Dioscorea alata*) for distribution to the headmen of the Kurunegala District through the Government Agent of the North-Western Province, with a view to encouraging the cultivation of this excellent tuber in the district. MR. NAGANATHER reports what is not generally known, that the yam thrives at high elevations (6,200 ft.)

In September the Society imported 3,200 lb. of acclimatised English seed Potatoes from Ootacamund and distributed to those who had booked orders beforehand in response to a notice in the TROPICAL AGRICULTURIST, the potatoes going to Nuwara Eliya, Kandapola, Maskeliya, Talawakele, Bandarawela, Pundaluoya, Welimada, Deltota, Mediwaka and Ambawela. The orders varied from 28 to 800 lb.

MR. A. J. KELLOW, who has had considerable experience and success in potato-cultivation, has been good enough to write with regard to seasons in Ceylon: "I have had the best results from July-August planting and fairly good from sets put down in February-March, but the climatic conditions vary so much in Ceylon that it would be impossible for me to give an opinion as regards any locality other than this. As a general rule, however, I would suggest a choice of season when a period of 3 months can ordinarily be depended on for pretty fair weather. i.e., without too much rain. If the plants are exposed to heavy rains after blossoming—which generally occurs

about 2 months from setting—they are liable to be affected by blight which is frequently transmitted to the tubers."

For the October planting season the Society distributed the following plants and seeds :—

Vegetable Seeds	packets	1,165
Seedling plants		1,117
Cowpea	lb.	134
Seed potato	,,	3,200
Indian grafted plants		426
Australian budded plants		30
Burmese drought-resisting paddy... ...		2 bush. 6 measures
Dura (Sorghum)	8	,, 14 lb.

The Society has now distributed between 10 and 11,000 grafted plants from India, and it has been decided not to import any more, at least for a time. Whether these imported varieties will prove suitable to local conditions and bear as good fruit as in India remains to be seen. Members are reminded that our local varieties of mangoes are as good as any if the right sorts are propagated and that every effort is made by the Society to provide the best of these.

MISCELLANEOUS.

Agricultural Education.—Arrangements have been made by the Director of Agriculture for the opening of a School of Tropical Agriculture at Peradeniya early in January, and so far a large number of applications for admission have been received. Two hostels are to be provided for resident students, and these will be in charge of responsible officers. Arrangements have been made for the erecting of temporary class-rooms on the grounds of the Royal Botanic Gardens, towards the cost of which the Agricultural Society contributed a grant of Rs. 1,000.

Poultry Rearing.—DR. H. M. FERNANDO and MR. H. L. DE MEL have approached the Secretary with a practical scheme for the improvement of village poultry, the cost of which they offer to meet. Details are under discussion and will be made known shortly.

Bee-keeping.—MR. THOMPSON, a visitor from India, had a consultation with the Secretary and the Assistant Entomologist with reference to bee-keeping in the East, and the Society's comb-foundation machine was specially worked for his benefit at the Government Stock Garden. MR. SHANKS, who still maintains his interest in apiculture, has kindly communicated to the Society the results of observations made with regard to the comparative weight of the English (*A. mellifica*) and the Indian honey bee (*A. indica*), viz., that while about 5,000 of the former go to make a pound, approximately 11,500 of the latter are required for the same weight.

MR. D. S. CORLETT, Manager, Experiment Station, Peradeniya, writes : "My bees have gone into the super and worked on all the frames which are pretty full up."

Soy Beans.—Reference has previously been made to the introduction of several new varieties of Soy Beans from Bangalore. At Balangoda Agricultural Garden 12 varieties were grown in plots 3 × 16, and of these the three best were found to be : (1) Willson, (2) Seka Leha and (3) Brown No. 2 (creeping variety) all of which gave a yield equal to between 6 and 7 cwt. of seed per acre.

The seeds were put down on July 12th, the plants flowered about the middle of August, and the crop was gathered in the first week of October, except in the case of Brown No. 2 which cropped 2 to 3 weeks later.

The pods, when about half-ripe, were attacked by field rats and the crop was thereby to some extent reduced.

C. DRIEBERG,
Secretary, C. A. S.

Peradeniya,
30th November, 1915.

THE EFFECT OF RADIUM ON THE GROWTH OF PLANTS.

E. J. RUSSELL.

Among the many remarkable properties of radium it was perhaps natural to expect that it might have some definite effect on plants, and even, under suitable conditions, cause sufficient increase in the amount of growth to justify its use in horticulture and agriculture. The early report noted a more or less complete inhibition in cell activities in younger and especially embryonic tissues, with few exceptions. The action of radium through the soil, however, was different; germination and growth were both accelerated, and the plants furthest away were stimulated most. ACQUA found that different plants, and even different organs of the same plant, were differently affected, the root system in general responding more markedly than the ærial parts, and in his experiments being arrested in their development.

The intensity of the radiation is important, and G. FABRE, using *Linum catharticum* as test plant, was able to obtain increased development and germination of seedlings by working with emanations up to 1·5 microcuries per 2 litres of air, and to retard development by using emanations of 40 microcuries per litre of air. H. MOLISCH obtained a like result: young plants of vetches, beans, sunflower, etc., were stimulated in growth by weak emanations, but checked or entirely stopped by stronger ones. He further claimed that the "rest period" could be broken by the radium emanation, and forced lilac into bloom in November by attaching pipettes containing small quantities of radium chloride to the terminal buds. In his earlier experiments he, like DIXON and WIGHAM, failed to detect any radiotropism, but later on he found indications in the case of certain heliotropically sensitive plants, e.g., oats and vetches.

These and similar results naturally suggested that the residues left after the extraction of radium, but still containing radio-active material, might have definite manurial value, and it was not long before definite statements were forthcoming. BAKER claimed that increased yields of wheat and radishes had been obtained by mixing one part of radio-active material (2 mg. ra. per ton) with ten of soil. It is true that STOKLASA's results were negative (although in his other experiments radium emanations increased growth to a marked extent), but this did not prevent the introduction of radio-active fertilisers, and the enterprising syndicates and companies concerned were by no means loth to push their wares. The staffs of the agricultural experiment stations being busy people and, moreover, somewhat sceptical about plant stimulation on account of some rather sad failures, did not generally take the matter up, and it remained for MR. MARTIN SUTTON to carry out the necessary tests.

MR. SUTTON's experiments were made with radishes, tomatoes, potatoes, onions, carrots, and marrows, some grown in pots, others in plots out of doors. Eight different radium residues were used, in addition to pure radium bromide; the dressings were so arranged that equivalent quantities of radium were given in each case (1/4,000 mgm. radium bromide to 15 lb. of soil in the pots; $2\frac{1}{2}$ times this amount per square yard to the plots). Controls were set up, including a set treated with the other substances present in the residues, designed to ascertain whether those had any effect.

The results have just been issued by MR. SUTTON. Going carefully through them, one is forced to the conclusion that the radio-active materials have been ineffective. In no case is there any clear evidence of increased growth. Even the pure radium bromide seems to have done nothing. We are, therefore, left with an apparent discrepancy. The work of

the physiologists, assuming it to be sound, certainly indicated that radium emanation is capable of stimulating certain cell activities. Mr. Sutton's results show that such stimulus, if it exists at all, does not affect the final growth of the plant. The discrepancy is not a new one; it is periodically confronting the agricultural investigator. Thus Dr. Winifred Brenchley, at Rothamsted, has failed to obtain increases in growth by supplying plants with inorganic poisons which have been supposed to stimulate certain cell functions in suitable dilutions. The result opens up the prospect of an interesting discussion, but it also shows the danger of arguing from a simple physiological observation to a complex phenomenon like the growth of a plant in soil.—Nature.

DIE-BACK OF LIME TREES IN MONTSERRAT.

As affording an interesting comparison with the description reviewed above of citrus branch troubles in the Isle of Pines, the following extract is published from a report made to the Imperial Commissioner of Agriculture respecting a recent short visit to Montserrat :—

'The factors concerned in the dying back of twigs and branches are possibly somewhat complicated, and cannot be determined with certainty by inspection and the examination of specimens. Observation of the sequence of events during their decline are necessary before a definite conclusion can be reached. Certain probabilities, however, may be indicated.

'Much of the die-back is complicated by the presence of scale insects on the branches which fail. I was able, however, to find instances where scale insects were practically absent and where there were no indications of their having been present in adequate numbers to account for the failure. I regard them in most cases as accessories merely, which hasten, but do not cause the death of twigs and branches. I am more inclined to believe that it is usually when the branch has already become sickly that they are able to increase to a serious extent.

'There are two fungi present on diseased branches at a sufficiently early stage and with so much regularity as to enable them to be regarded as possible parasites. The first of these is a species of Colletotrichum whose fructifications are found everywhere in the islands I have visited on dead or dying lime twigs. It closely resembles the withertip fungus of American writers on citrus diseases (*Colletotrichum gloeosporioides*) but has not been found to cause any such effects on leaves and fruits as are recorded for that fungus. A case has been seen on a young tree in Barbados which left little room for doubt that this fungus can under some circumstances bring about the death of twigs and small branches. I have not seen any indication of its presence on larger branches.

'On such diseased main branches as were examined in Montserrat, the fungus found working up to the margin of apparently healthy wood and fruiting on the dead bark is a Diplodia, which appears to be the same as the well-known cacao fungus. In the case of cacao it is associated with the die-back that occurs on trees in exposed situations, usually in circumstances which make it difficult to decide whether the die-back has attracted the fungus, or the fungus has caused the die-back. The general opinion, to which I myself adhere after a period of doubt, is that it acts as a parasite on trees weakened by unfavourable conditions. It may very well be found to have a similar position in respect of lime trees.'—W.N. in the Agricultural News.

LOSS OF WATER FROM WEEDS.

LYMAN J. BRIGGS, M.S., Ph. D.

A relatively small proportion of the total annual rainfall is conserved in the fallow. The maximum quantity of stored moisture available for crop seldom exceeds 4 inches of rainfall in sections where the annual rainfall ranges from 13 to 18 inches. This low efficiency is due in part to loss from run-off, but mainly to surface evaporation, and to loss through the transpiration of weeds. Numerous measurements have shown that a rainfall of less than ½ inch does not contribute to the permanent store of moisture in the soil unless the surface soil is already wet from previous rains. If the rainfall penetrates the soil below a depth of 6 inches, its rate of loss due to evaporation is low. But if the fallow is weedy, the stored water is lost through the transpiration of the plants almost as rapidly as if the moist subsoil were freely exposed to the air. The water requirement of weeds is fully as high as some of our most valuable crop plants. For example, pigweed (*Amaranthus retroflexus*), tumble-weed (*Amaranthus græcizans*), and Russian thistle (*Salsola pestifer*), have a water requirement as high as the millets and sorghums, while sunflower (*Helianthus petiolarus*), and lamb's quarters (*Chenefodium album*) rank higher than many of the legumes. The dry-farmer can therefore produce a valuable forage or grain crop with no greater expenditure of water per pound of dry matter than is lost through the weeds on his fallow.

Determination by W. W. BURR, in Nebraska; R. W. EDWARDS and J. G. LILL, in Kansas; and C. B. BURMEISTER, in Texas, all unite in showing that the evaporation loss from land from which the weeds are sliced off with a hoe is but little greater than from cultivated plats. In other words, cultivation is effective in conserving water mainly through the destruction of weeds rather than in the reduction of surface evaporation. This is well illustrated by LILL's measurements at Garden City, Kansas. The moisture content of the mulched plat did not differ markedly from the plat on which the weeds were kept sliced off with a sharp hoe; while the plat on which the weeds were allowed to grow was dried out to a depth of 3 feet.

A striking example of the loss of moisture from weeds is also shown in experiments by P. V. CARDON, at Nephi, Utah. Winter wheat was grown on four plats by the summer fallow system, one-half the plats being in wheat each year. Two plats were fall-ploughed each year, and during the following summer, one plat was cultivated to destroy the weeds, while the other was left untouched, except to clip the weeds in time to prevent the seeds maturing. In the autumn, both plats were sown to winter wheat. The experiment was conducted for four years, and during this time the yield from the cultivated plat averaged 4 bushels more per acre than from the weedy plat.

The loss of moisture in these plats as the season advanced, due to the demand made by the weeds, is illustrated in the accompanying graphs, Fig. 4. (*Not reproduced*). That this loss is primarily due to the weed cover, and not to direct evaporation, is supported by the fact that in other experiments at this station, spring-ploughed, uncultivated fallow on which the weed-growth was slight was practically as effective as cultivated fallow in conserving moisture. The average moisture content (6 feet in depth) of the weedy Nephi plat was, at the time of the spring sampling, 0·8 per cent. below the cultivated plat; and at the time of the fall sampling, 4·5 per cent. below the cultivated plat. This loss in moisture during the summer is equivalent to 3·5 inches of rainfall *stored in the soil*. This amount of water is sufficient, according to the water-requirement measurements of BRIGGS and SHANTZ, to produce 10 bushels of wheat per acre at Akron, Colorado, where the evaporation is the same as at Nephi. In 1911, the actual increase in yield of the

cultivated plat over the weedy plat was 11 bushels per acre. During the other years, the yield was reduced by winter-killing, so that the water supply was not the primary factor in determining production. Surely no more convincing proof is needed of the necessity of keeping fallow land free from weeds in regions where the moisture supply is of primary importance!—JOURNAL OF AGRICULTURE, VICTORIA.

ANT EXTERMINATION.

For the extirpation of ants the following remedies are good. To be effective, they require attention and perseverance. It is well to find their main burrow or nest, if possible. Arsenic is sure destruction to them, but it is dangerous to handle :—

Air-slaked lime plentifully dusted in warm dry weather over and around the hills, or in the house or other places infested, will cause the ants to vacate them in a short time.

Snuff: Dust a little snuff upon the floor of the rooms or pantry.

Draw a thick chalk line around a smooth tree or across an upright board or post, and they will not pass over it.

Camphor: Put a piece of camphor, the size of a filbert nut, into 2 quarts of hot water. When cold, apply to pot and other plants, and the insects will be driven off without injury to the plants.

Mix together 1 part of calomel and 10 parts of finely powdered white sugar, and lay it in little heaps about their nests and runs. The ants will eat it and die.

Coal oil, mixed with six times its bulk of water, sprinkled over the nests every few days, will kill and drive them away.

Pans or saucers, nearly filled with honey or sweet oil, attract ants, and they are drowned in it.

Flowers of sulphur, ½ lb.; potash, 4 oz. Set in an earthen vessel over the fire until dissolved and united. Afterwards beat to a powder. Infuse a little of the powder in water and sprinkle in places infested with ants.

To Destroy Black Ants: A few leaves of green wormwood scattered among the haunts of black ants will drive them away.

Red Ants: Powdered borax sprinkled around will exterminate both red and black ants.

Make holes in the ant hills, 6 in. deep and 1 ft. apart, with an iron or zinc tube fitted with a wooden stake. Withdraw the stake. Pour 1 tablespoonful of bisulphide of carbon down the tube. Withdraw the tube and stop the hole immediately. Bisulphide of carbon is very inflammable.—QUEENSLAND AGRICULTURAL JOURNAL.

POISONOUS PLANTS.

TO THE EDITOR OF THE TROPICAL AGRICULTURIST.

DEAR SIR,

In connection with the interesting article on Poisonous Plants communicated by Mr. H. F. MACMILLAN to the October issue of the Journal it may be added with reference to *Gloriosa superba* that there is a strange notion locally prevalent about it, viz., that the poisonous properties are transferred from the aerial to the subterranean parts of the plants during the day and vice versa at night time, so that pasturing animals may eat the foliage with impunity in daylight and such animals, like the pig, as dig for their food may consume the tubers after dark without any evil effects.

Yours truly,
C. D.

PROGRESS REPORT, PERADENIYA EXPERIMENT STATION.

(15th August, 1915, to 15th October, 1915.)

TEA.

The return for the month of August was 1,566 lb. green leaf, and for September 2,237 lb. from five acres.

Dadaps in plots 144 and 149 were pruned in October, yielding 1,791 lb. green leaf and 1,120 lb. per acre respectively.

All pruned plots have been tipped, three months after pruning.

All drains have been cleaned.

RUBBER.

In the beginning of October, plots 11, 12 and 13 were supplied with 40 stumps raised from seed of No. 2 tree (Heneratgoda).

COCOA.

The Dadap shade in all the plots has been thoroughly lopped for the second time this year.

A round of canker has been finished, the cankered bark being lightly cut off and the diseased area rubbed over with copper sulphate, instead of as hitherto practised, the whole affected area being cut out down to the wood.

By this treatment it is hoped the fungus will be killed and the wound heal quicker.

Owing to the continued damp weather much pod-fungus is prevalent.

Picking will be carried out every two weeks to check the spread of the fungus.

Lime at the rate of 2 tons per acre was applied to the plots in Experiment C in September.

Lime has also been applied to a poor patch of ¼ acre in DR. LOCK'S plot. All the young trees in this plot have also been forked round.

The artificial manures necessary for manuring the cocoa experiments have arrived and been stored ready for application in February.

Three rounds of pickings have taken place. The last lot was fermented for only 36 hours; this being sun-dried, has given the beans a remarkably fine colour.

COCONUTS.

As only Rs. 22 per 1,000 nuts were offered at the last auction in September, the nuts were not sold but turned into copra and sold in Colombo for Rs. 52·00 per candy giving us a profit of Rs. 90·00 on the consignment over what the nuts would have sold for.

Lime at the rate of 2 tons per acre has been applied in September to the plots in the new scheme for manuring the 11 acres of young palms.

The plots have all been kept well disc-harrowed and the palms weeded round.

The beetle-traps have been re-set against the rainy season as rhinoceros beetle has again become very prevalent.

PADDY.

The six weeks old seedlings from DR. LOCK'S selected paddy were transplanted from the nursery on the 6th September and planted 6 in. by 6 in. single plants. The ¼ bushel sown only supplied enough plants to plant 1 acre, so that the remaining ½ acre had to be supplied two weeks later, from plants thinned out from the portion sown broadcast.

The field has been divided up as follows:—

½ acre above road broadcasted 23rd August. 1 acre below the road, right hand side of the drain broadcasted 23rd August, at the rate of 1 bushel per acre. Plants have been thinned out as they were too thick. Plots were weeded early in October.

Left hand side of drain 1½ acres transplanted 6 in. by 6 in.

Two small plots of Hondarawala "hill" paddy sown broadcast on 6th September and one small plot of Philippine paddy the plants of which were kindly supplied by MR. BEDDEWELA of Kandy, planted 7th October.

The transplanted is showing a remarkably vigorous growth and is stooling very well.

The whole field looks in a much healthier condition than last year, save where the levelling necessitated the removal of the surface soil to fill in the low portions.

These poor portions should recover in time after cultivation and green-manuring.

There are five factors at work on the improvement of the field, namely :— Draining, dry-ploughing, levelling, controlled water supply, and selected seed from last crops.

DURA.

The red variety of Sudan Dura picked out of the other varieties, white and yellow, from the Soudan and sown 17th June was harvested on October 10th, i.e., 115 days from sowing.

The crop was very fine and made a good show when ripening with its rich, red colour. The stem borer (*Chilo simplex* and not *sesamia inferens* as previously stated) which attacked the plants does not appear to have done much damage, but the stalks are all being burnt on the fields to kill all eggs and larvæ still in the stalks.

A variety, pink in colour and more easily detached from the husk when threshing, has been observed and kept apart for resowing and obtaining yet another variety.

The whole of this red Dura as well as 25 bushels of the other varieties have been distributed to the Government Agents of the North-Central, Northern, Eastern, Uva and Central Provinces, and to the Secretary, Agricultural Society, as well as to private individuals, for free distribution to chena and other cultivators to grow and report on.

It is thus hoped to familiarise the Ceylon goiya with this valuable grain.

COFFEE.

The young coffee plants have each been given ½ lb. basic slag reserving several rows in each plot as controls.

The five year old Robusta has been manured according to the scheme tabled at last meeting.

All the new plots have had the shade-dadaps lopped and the leaves mulched round the plants.

The sweet-potato, sown to smother the Cora grass, has been uprooted as the shade from the Dadaps should be sufficient to check the growth of the Cora.

Green-bug is common on all the young plants but is kept in check by spreading the fungus *Cephalo sporium*.

The hybrid trees round the Show plots are bearing a remarkably heavy crop.

MANILA HEMP.

The plants received from the Philippines in August 1914 are now 10 feet high and are producing quantities of suckers. These are being distributed to Hakgala and other places.

The plants are being manured to show a vigorous growth.

ECONOMIC PLOTS.

In the fibre plots the Jute and C. Juncea have been uprooted, the seed being saved for replanting, and the sesamum has been harvested in the old plots.

These plots have been ploughed for resowing. The remaining plots of 10 acres, sown in peas and other pulses to improve the soil, have been ploughed and disced ready for sowing in legumes.

Owing to retrenchments the establishing of these plots in economic products must be again postponed.

KITCHEN GARDEN.

The limes planted in June 1913 are flowering and some fruit is setting which shows healthy growth for only two years old. They have been kept well cultivated and the ground-nut mulch intergrown, dug in round them with a little cattle manure twice a year.

The pines have been well manured.

LABOUR.

Ample for the means we are allowed. New lines on hill top have been re-roofed with iron by the Public Works Department.

DUDLEY S. CORLETT,
Manager,
Experiment Station, Peradeniya.

A RUN THROUGH JAVA.

C. A. C. CUNINGHAM.

The steamer anchored about a mile from the wharf, and I went ashore in a motor launch, with the sun pouring down relentlessly. After much difficulty and delay in getting through the Customs, and obtaining my railway ticket, caused largely by my ignorance of the Dutch language and Dutch money, I took my seat in the train bound for Weltevredin (New Batavia). After a run of about half-an-hour through low-lying swampy ground and cocoanut plantations, and for some distance along the side of a rather dirty looking canal, in which were numerous bathers, I left the train, and obtained a gharri (vehicle), and was driven to my hotel. Here I had the pleasure (?) for the first time in my life of tasting the Javanese national dish, known as a "Rice Taffel." It is a mixture of rice, curry, chicken, eggs, jam, fruit, pudding, and numerous other things and flavourings of all sorts thrown into a basin and mixed up. I did my best with it and survived, but I hope Providence may, in the future, preserve me from being again so foolhardy as to partake of this wonderful production of the culinary art. I remained a few days in Weltevredin, seeing its museum, streets and buildings, and other sights, and driving out to Old Batavia, and having a look at its old-fashioned streets and decaying houses, with its river thickly studded with native barges and old-time craft. As cholera was rather rife, I determined to move on, so early one morning I took the train to Buitenzorg, about 30 miles or so situated 857 feet above the sea. I passed through a most picturesque country up through the mountains among cocoanut and banana plantations and native

villages, the fresh morning air and the novelty and beauty of the scene adding a zest and a delight to everything. My chief object in visiting Buitenzorg was to see the far-famed, world-renowned Botanical Gardens. Previous to seeing these gardens, I had always considered the Botanical Gardens at Singapore the most beautiful I had ever seen. I am, however, constrained to admit that in my opinion they must take second place to those at Buitenzorg. They are a perfect paradise on earth. The collection of orchids, all growing in the open, is wonderful, and covers a large space. The *Victoria Regia*, with leaves probably 4 feet in diameter, floats in silent beauty and majesty on the still waters of the lake in front of the Governor's Palace, and the splendid collection of economic and other trees and shrubs makes picturesque and shady avenues, along which one can saunter leisurely to find some shady nook in which to rest and watch the native gardeners working in their own peculiar way. My visit to these gardens will always remain one of the most pleasing memories of my many travels. From Buitenzorg I went by train—a seven hours' journey—to Garöet, 2,000 feet above the sea. This town is encircled by 14 volcanoes, and is the centre of an intensely cultivated district, rice, coffee, bananas and coconuts growing in perfection. The rice cultivations are, indeed, well worth seeing. The little plots which extend as far as the eye can reach, are all irrigated, and the hills are terraced and irrigated nearly up to the top. The general effect is beautiful and picturesque in the extreme. The manner in which the Javanese cultivate and irrigate the rice fields strikes one with profound admiration, and is a wonderful monument to their industry and engineering ability. Hundreds of them, men, women and young people are to be seen working together in the fields. Sometimes they are to be seen ploughing with an antiquated wooden plough drawn by a water buffalo, at other times planting, and at others plucking the ears of rice one by one, and making them into little bundles—a peaceful, contented, happy and delightful scene.

Making an early morning start, I drove about nine miles, and then got a pony and a native guide, and by various winding paths and mountain tracks, through rice, coffee, tea, tapioca, tobacco and banana plantations reached "Papandajan," an active volcano situated about 8,000 feet above sea. The excursion was very pleasant, but the mountain tracks were very rough, and, in some places, very steep. I passed through some miles of jungle, reminding me very much of the New Zealand bush. I also visited Lake Bagendit, and crossed over it on a native raft paddled by four pretty native girls, and then visited some hot springs a few miles distant. From Garöet I had another seven hours' train journey to Djokdja, and, after seeing the water castle and other sights, trammed and drove to Boroboedoer, and spent a day inspecting and admiring its wonderful temple built between the eighth and ninth centuries. It is justly considered to be one of the wonders of the world, and is supposed to represent the transmigrations of the soul and the life of Buddha. There is no interior to it. It consists of a series of terraces all beautifully carved, and on the outside walls of these terraces sit in apparent meditation innumerable statues of Buddha. The view obtained from the terraces is lovely in the extreme, extending, as it does, for miles over a fertile and highly cultivated plain covered with rich tropical vegetation. In returning to Djokdja, I visited the temples of Mendöet and Pawon, in the former of which are immense statues of Buddha and two princes. The next place of interest which I visited was "Tosari," a sanatorium 6,000 feet above sea. It is truly a picturesque spot, and is much patronised and appreciated by people living in the lower parts of Java. A blanket at night is indispensable, and one morning a very slight frost was discernible. From Tosari I rode out about 10 miles to Bromo, another active volcano. In going to Bromo it is necessary to cross the Zandzee (a sea of sand). It is the bottom of an extinct crater, and is 7,000 feet above sea level. After crossing this the foot of the Bromo is

reached, and then a climb, 253 steps made by the Dutch Government, brings one to the mouth of this active volcano, down which a clear view is obtained.

From this point is also obtained a splendid view of "Smeroc," another active volcano, 12,000 feet above sea level, and the highest mountain in Java. From Tosari I went to Sourabaya, and thus ended my travels in this beautiful and fruitful island. As this paper is somewhat longer than I intended, I shall not describe the sights of Sourabaya, or refer to other parts of Java which I visited. Neither shall I refer to some of its other products further than mentioning that sugar cane is extensively grown, and large sugar mills are to be seen in several parts of the country. Cinchona, from which quinine is obtained, is also grown to a certain extent. To sum up, Java is only a little less in area than the South Island of New Zealand.* It is a rich, picturesque, and productive country, supporting 35,000,000 of people, nearly all of whom are natives living in small crowded villages, and, as is well known, it is a portion of the Dutch East Indies. It has no parliament of its own, and is governed from Holland. On the whole the hotel accommodation is good, and the charges reasonable. The railways are comfortable, and the fares moderate. To anyone who has not seen it, I think it is well worth a visit.—JOURN. OF THE CANTERBURY AGRIC. AND PASTORAL ASSOCIATION.

CONTROL OF FLIES IN RURAL DISTRICTS.

C. W. HOWARD.

DR. H. W. HILL, of the Minnesota Public Health Association, has recently said that the rural fly is worse than the city fly and that "death and disease caused by flies is confined chiefly to rural districts." This fact has been recognized by this office for some time and our work against the house-fly has been conducted almost entirely with this in view. These facts are not usually given the consideration which they deserve probably, in part, because our statistics upon the prevalence of diseases in rural and country districts as distinct from cities and towns are extremely meagre. It is not our purpose at this time to enter into a discussion of what diseases may be carried by the house-fly, or how and when it acts as the carrying agent. That subject has been dwelt upon so often that the facts are now common knowledge. To the thoughtful person, it will soon become evident that there must be less danger of disease transmission by flies in our modern cities where sewers provide for the removal of infectious materials from sick people and where houses are for the most part well screened to prevent the access of flies to infectious material or, in turn, to food where they may deposit their load of germs. But in the small towns and farm districts, where no attention is given to sanitation, not even to fly-proofing the outdoor closets, every chance is given for flies to gather up infectious germs.

The same rules must apply to fly control both in rural districts and in cities, the application being modified to suit differing conditions. The campaign of "swat the fly" and the use of fly traps, while serving a very valuable end in arousing public opinion, will never reach the root of the evil. They are like the medicine which the doctor prescribes to relieve the painful symptoms of a disease. We have reached the stage in fly control when we are ready to prescribe not for the symptoms but for the causes of the trouble. We must destroy the flies before they get wings; or, better still, we must prevent them breeding at all.

* Area of the South Island of New Zealand, 58,000 square miles. Area of Java, 50,554 square miles.

With this in view, we must remember that fully 95 per cent. of all our house-flies come from horse-manure. Hence one of the first places to receive our attention must be the litter about horse stables. It has been taught in the past that manure, to be best for fertilizer, must be placed in piles and allowed to rot. Modern research has shown, however, that this is not correct. It is preferred now to spread out the manure upon the field as fast as made. In the handling of manure, the object to be aimed at is to prevent the loss of the plant food which it contains. The chief sources of loss are through fermentation and the leaching which results on exposure to rain. These are prevented by the spreading of the manure on the field, where it quickly dries and, when ultimately plowed into the soil, none of its plant food content has been lost.

This system gives us a method of prime value against flies. The house-fly prefers very fresh horse-manure which has begun to ferment sufficiently to provide considerable heat and which is fairly moist. These conditions are found in the ordinary manure pile on to which fresh manure is thrown each day. If this could be drawn out at frequent intervals, say daily, from large stables, or not less than twice a week from smaller stables and spread out on a field, the conditions favourable to flies would be avoided. Even if the flies were able to lay their eggs in the manure before it was drawn out, the fact that it is spread out thinly and dries out rapidly causes the egg and young maggots to die quickly. At first thought, this system may seem to involve excessive labour, but our experts to-day in farm management feel that it is perfectly possible to put into practice with little, if any, additional labour, providing a little thought is given to planning the routine on the farm.

On the farm, it is perfectly possible to carry out the above system regularly, but in the smaller towns and villages stable litter cannot be removed so often, either for lack of means for carrying it away or for lack of a place to which it may be taken at once. In such places it is necessary to store up the manure for some time until enough has accumulated to make it worth while to haul it away or until a place is found to which to send it. This, of course, is exactly the condition which gives the flies a chance to breed and multiply. But even here, their breeding can be prevented by storing the manure in a tight receptacle. Where there are gardeners who will collect it once or twice a week, a garbage tin or even a barrel with a tight cover will serve the purpose if there is only one animal in the stable. Where there are several animals, a closet or bin can be constructed at very small cost in which to store the manure. The closet should be built in or attached to the stable, with a screen door through which the manure can be thrown at the time of cleaning and also to provide for ventilation. An outer door enables one to clean out the closet without entering the stable. One essential must be observed; that is, the closet must be constructed tightly so as to give no chance for flies to work their way to the inside and reach the manure. For this same reason, the doors must fit snugly and **must be kept closed all the time,** except when actually throwing in or removing manure. The floor should also be tight so as to prevent liquids seeping through.

The closet may take the form of a lean-to on the outside of the stable or in small stables may take the form of a cement bin, with cover and front both movable to facilitate filling and emptying. The greatest objection to these bins is that they must be opened wide when placing litter in them and at this time flies may enter and deposit their eggs. Thus, without the most painstaking care, they may become as great fly producers as the open manure pile. Much better is the lean-to or shed opening from the darkest corner of the stable.

It has been stated that pits constructed in a dark portion of the stable would prevent flies breeding in the manure placed therein, because flies will not breed in manure in the dark. It is, however, a well-known fact that flies

will breed inside of a very dark portion of a stable. Many observations were made during the past summer upon this point. We repeatedly found fly maggots in the manure which had been allowed for one reason or another to collect in dark corners. In many cases the light was almost entirely absent, yet flies bred there. So it does not seem advisable to consider manure pits as a satisfactory means of keeping manure from fly infestation. The manure closets are safer as well as making it possible to handle the manure with less labour.

The writer has had the opportunity to watch the results following the use of a manure closet during the past summer. In former seasons, when the stable litter was thrown outside and only removed twice a year, the entire neighbourhood suffered from a plague of house-flies. But the past season, following the construction of the manure closet, flies have been almost a negligible quantity. The stable in question was the only one in the immediate vicinity, so that the results were very plain.

EXPERIMENTS ON A FARM.

To test the possibility of exterminating or at least materially reducing the number of flies on a farm, work was begun last summer on the University Farm attached to the Agricultural College. This farm was chosen because it offered very exaggerated conditions and we felt that if we were successful under such conditions, a similar plan would be perfectly feasible on an ordinary farm. There are, on the University Farm ten distinct buildings used to house animals which numbered about as follows during the summer: 31 horses, 195 cattle, 125 sheep, 20 pigs. We included all of these stables because flies will breed in almost any manure when necessity forces them to do so. The plan from the beginning was to follow the simple method of drawing out the manure from each stable at least twice a week. There was not sufficient land to make it possible to spread out such a quantity of manure at once, so it had to be placed on a compost heap. To meet this difficulty and kill the fly maggots which would breed there, the compost heap was sprayed each week with a poison spray prepared as follows: Arsenite of soda, 4 pounds, molasses, 4 quarts, water 50 gallons. We met many obstacles, for the whole system was new; there was difficulty in persuading the attendants to thoroughly clean out every corner and crack of the stable floors where manure might collect and flies breed; the quantity of manure was so large that there was difficulty in getting it sprayed promptly when drawn on to the compost heap; certain contractors who were working on the farm at the time did not give as close attention to the manure from their temporary stables as they should have done. But taking these facts into consideration, its value seems evident when we say that flies were not more than one-quarter as abundant this summer as during the previous seasons. This shows the value of prompt removal of manure. The further perfection of our present system will, we confidently expect, give us much better results the coming summer.

It may be well to mention here a fact which came to our attention while carrying out this work. The compost heap on a neighbouring farm was found to be breeding no flies at all. Upon investigation we found that so much straw was used for bedding in the stables that the manure dried out quickly on the compost heap and offered no attraction to flies looking for places to deposit their eggs.

While fully 95% of our house flies come from horse-manure, they will not despise other material, such as kitchen garbage, in which to rear their young, if nothing else is available. We have bred house-flies from such material as decaying watermelon and others have bred them in banana peel, rotten bread and cake, decaying rags and paper, etc. In this connection, we must also consider such flies as the "blue bottle" (*Lucilia sericata*), the flies with a metallic green or blue sheen, which breed in garbage or decayed animal matter and which often enter the house in company with the house-fly.

We must remember that collections of garbage are one of the favourite dining places of the fly. The Minnesota State Board of Health, in its report for 1911, points out that one of the forms of dysentery which attack the residents of Minnesota in the summer, comes from the bacteria found in decaying fruit and vegetables and that flies feeding on such fruit bring them later to our own tables. Even putting aside the question of disease transmission, who wishes flies to be visiting the garbage-pile and then coming in to wash their feet in the milk upon the table or crawl over the butter? Consequently, we must turn our attention also to sanitary conditions about the house if we wish to completely control flies.

GARBAGE AND SEWAGE.

The question of garbage disposal in rural districts is a serious one. For small towns with inadequate funds to establish a garbage collecting system modelled after those of our large cities is impossible, but much can be done to accomplish the end desired in another way. Garbage should never be thrown into the backyard and allowed to accumulate. Much material which usually goes into such piles can easily be burned in the stove, and many housewives prefer to do this rather than have the unsightly odorous garbage pile in the back yard. That which cannot be easily burned can be disposed of otherwise. Where manure is being drawn out from the stables daily or twice a week or even once a week, the garbage can be collected in a tightly covered tin and emptied into the wagon with the manure. When spread out on the field it will dry quickly and cause no further annoyance. In other cases recourse must be had to burial of garbage. Unless carried out with certain precautions, this is followed with some danger of producing flies. If the garbage becomes "fly-blown," the adult flies will be able to work their way up for considerable distances through the soil. It has been recorded that flies cannot emerge through a covering of six inches of ordinary soil, while another record says that house-flies emerged through 48 inches of soil, and other species such as "blue-bottle" flies through 72 inches of sand. Doubtless much depends upon the character of the soil, as to whether it is compact and apt to crack, or loose and soft but apt to pack firmly with rain.

Some experiments carried on at the University Farm during the past two summers show that under indoor experimental conditions as many as 25 % of adult house-flies may work their way to the surface through twelve inches of a black, sandy loam. Under natural outdoor conditions, where fly maggots in garbage and manure were buried in twelve-inch porous tiles, a maximum of two "blue bottle" flies and eight house-flies were able to reach the surface from one foot depth through the same black sandy loam; at two feet depth a maximum of eight blue-bottles reached the surface and from a depth of three feet seven blue bottles and one house-fly reached the surface. These were from a total 500 maggots, half blue bottle and half house-fly maggots which were buried in each tile. Apparently the exact depth of burial makes very little difference as to the number of adult flies reaching the surface. The reason for this cannot be fully explained. It seems apparent, however, that very few will reach the surface when garbage containing maggots is buried under one foot of soil, and when the exposure is such that the soil will be compacted with the rain and moisture as was the case in the above-described outdoor experiments.

To make the burial of garbage entirely satisfactory, one precaution must be taken. A metal garbage tin with a tight-fitting top should be provided in which the garbage is placed at once. When the can is full, it can be emptied into the pit. If the cover has been faithfully kept in place on the can so that no flies could gain admission and lay eggs, and if upon removal from the tin, the contents are at once covered with a layer of soil through which the flies will not lay their eggs, all danger is obviated. Wrapping each lot of garbage in old newspaper before placing it in the can will facilitate the handling of the

material at the time of burial and also prevent the can from becoming too uncleanly. Under any circumstances, the can should be frequently scrubbed out as the odour will quickly attract your neighbours' flies. A filthy garbage can may become as objectionable to eye and nose as the garbage pile or slop hole.

There is still a better method for the disposal of garbage in small towns. Where there are sufficient funds available for building and operating an incinerator, the burning of the garbage is certainly the quickest and safest method of disposal. There is now for sale in Minnesota a locally-made incinerator, which costs only a small sum, quite within the reach of a village purse. This has been recommended to the writer as entirely satisfactory in its working. The use of an incinerator necessitates the collection of the garbage at regular intervals, which means extra labour as does the running of the incinerator. The services of one man with a horse and a suitable wagon should be sufficient for the collection of the garbage of a town of 2,000 inhabitants. The same man should be able to operate the incinerator. During the winter months, the collection can be abandoned, providing prompt cleaning up follows in the spring, so that the cost of operating such a system should not be a great burden, especially when we consider the results which must follow its installation.

A third source of danger to the rural resident is the out-house or privy. Outside of the cities so little attention is given to these places that in nine cases out of ten, they are an offence to every sense, not considering their danger from the hygienic point of view. The house-fly breeds readily in human excrement when no horse manure is available and also feeds greedily upon it after reaching the fly stage of its life history. The blue bottle fly also breeds in human excrement and feeds upon it. We must remember that the most dangerous diseases of man which the fly carries are the intestinal diseases, such as typhoid, dysentery, and summer complaints of children. In the open and tumble-down farm or village privy, every chance is given for the fly to cover its body with the infectious material contained beneath. It is usually not far removed from the kitchen and the odour of the cooking dinner attracts the fly from these places, with the inevitable result. Consider the danger to the farmer's family from chance visitors who may be bearing the infection of some intestinal disease and not be aware of its presence or danger.

We need not dwell further upon this unpleasant subject. Sufficient has been said to show the danger and the need for drastic changes in household sanitation in rural districts. The primary essential of a privy is that it be made fly proof, so that no fly may enter above or below. The ventilators and window must be covered with wire screening; the door must fit tightly and have a spring attached so that it closes promptly and stays closed; the seat should have a cover so constructed that it closes automatically when not in use and cannot be left open. If the type known as the earth closet is followed, the building should fit well down on to the surface with the soil banked up around it if necessary

The earth closet is not as sanitary as other types, owing to the danger of soil infection and the difficulty of keeping them odourless. Much better is the type where a receptacle such as a large metal bucket is used, which can be emptied at frequent intervals and the contents buried at some distance from any source of water supply. Where such a closet as this is built, the floor upon which the receptacle stands should be made, like the remainder of the building, of tightly fitting matched lumber and the door for its removal should also close tightly. Such a privy will cost comparatively little for its construction, and "when you find a fly on your food or in your milk, you will know one place that fly did not come from."

Still better than the fly-proof, outdoor closet is the septic tank system for the disposal of sewage. It has the advantage of providing for the kitchen waste and the sewage from closet and bath-room at the same time. Before its

installation, there must be provided a supply of running water from some source. The theory of the septic tank is that the storing of sewage in large chambers allows bacterial action to break down all solid material and renders it semi-liquid so that it can then be run off through underground tile piping on to the land. Whether the disease producing bacteria are all destroyed or not is open to question, but from the stand-point of the fly danger, they are placed where flies can never come in contact with them. A properly-constructed septic tank should need no attention for cleaning out for two to three years at a time. The cost of construction is comparatively small if it is not necessary to hire labour for the work. Seventy-five dollars should cover all costs, including labour for a tank large enough to care for the sewage from an ordinary farm house. Many small towns are now installing septic tanks of a size sufficient to care for their sewage. In other cases, several families in small towns are clubbing together and putting in a system suited to their needs. There is certainly no method more satisfactory from the hygienic standpoint, either for the single householder or the small town or village. It is not possible in the space at our disposal to give details for the construction of a septic tank. The reader is referred to Bulletin No. 57, of the U. S. Department of Agriculture, entitled "Water Supply, Plumbing and Sewage Disposal for Country Homes." This can be secured by writing to your Congressman and requesting a copy.

CONCLUSION.

Last of all, we must not forget the proper screening of our houses. The writer will not hold out any false hopes, for under farm and rural conditions, it must be an extremely thorough system which will not allow a few flies to escape destruction. We can reduce them to minimum numbers on our own premises but some breeding place may escape our attention or our neighbours may not be as careful as we are and it is well to be provided against the results. This does not mean that we should let down the bars and give them complete liberty of life and reproduction. In screening a house, remember that the poorly-fitting or broken and torn door or window screen may render your house a fly trap and retain the flies where they can do the most harm rather than keeping them out. In this connection, it may be well to also call attention to the fact that we should never purchase food from a store which is full of flies and which exposes food uncovered or makes no attempt to screen its doors and windows. Such food may be contaminated with disease germs before it is purchased.

To summarize the measures which should be followed on the farm or in the rural community to control the house-fly, the following points should be emphasized:

1. Prevent their breeding in stable manure by drawing it out daily if possible, or at least twice a week in summer, and spreading it out on the field. If it cannot be drawn out so often, then store it in fly-proof manure closets or bins, or even in covered barrels.

Prevent breeding in kitchen garbage by storing garbage in tight tins until it can be drawn out, buried or burned.

Prevent breeding in privies or outdoor closets by making them fly-proof.

2. Prevent the possibility of flies carrying disease infection by proper disposal of garbage.

By constructing privies fly-proof or by installation of a septic tank system.

By fly-proofing the houses and by insisting that dealers in food make their stores fly-proof.

If these suggestions were carefully followed, I am sure that our annual loss from typhoid fever in Minnesota would be reduced from $1,152,000 to less than half that sum, not to mention losses from other diseases which are borne entirely or in part by flies.

Those wishing further details or advice upon the subjects mentioned are requested to write to the Division of Entomology, University Farm, St. Paul.—

CIRCULAR NO. 33 OF THE MINNESOTA EXPERIMENT STATION.

MARKET RATES FOR TROPICAL PRODUCTS.

(From Lewis & Peat's Latest Monthly Prices Current.)

	QUALITY.	QUOTATIONS.
ALOES, Socotrine cwt.	Fair to fine	40/ a 50/
Zanzibar & Hepatic ,,	Common to good	40/ a 70/
ARROWROOT (Natal) lb.	Fair to fine	5d
BEES' WAX cwt.		
Zanzibar Yellow ,,	Slightly drossy to fair	£7 10/ a £7 15/
East Indian, bleached ,,	Fair to good	£8 10/a £8 12/6
,, unbleached ,,	Dark to good genuine	£6 5/ a £7
Madagascar ,,	Dark to good palish	£7 15/ a £8 2/6
CAMPHOR, Japan lb.	Refined	1/7 a 1/8
China cwt.	Fair average quality	155/
CARDAMOMS, Tuticorin	Good to fine bold	5/9 a 6/
per lb.	Middling lean	4/8 a 5/4
Malabar, Tellicherry ,,	Good to fine bold	5/9 a 6/3
Calicut ,,	Brownish	3/9 a 5/3
Mangalore ,,	Med Brown to good bold	4/ a 6/4
Ceylon, Mysore ,,	Small fair to fine plump	4/ a 6/4
Malabar ,,	Fair to good	3/2 a 3/4
Seeds, E. I. & Ceylon ,,	Fair to good	4/ a 4/3
Ceylon "Long Wild" ,,	Shelly to good	2/3 a 3/6 nom.
CASTOR OIL, Calcutta ,,	Good 2nds	3½d
CHILLIES, Zanzibar cwt.	Dull to fine bright	50/ a 60/
Japan ,,	Fair bright small	60/ a 70/
CINCHONA BARK.—lb.	Crown, Renewed	3⅜ d a 7 d
Ceylon	Org. Stem	2d a 6d
	Red Org. Stem	1¾ d a 4¼d
	Renewed	3d a 5¼d
	Root	1⅝d a 4d
CINNAMON, Ceylon 1sts.	Good to fine quill	1/3 a 1/9
per lb. 2nds.	,, ,,	1/2 a 1/7
3rds.	,, ,,	1/1 a 1/6
4ths.	,, ,,	1/ a 1/3
Chips,	Fair to fine bold	2d a 4d
CLOVES, Penang lb.	Dull to fine bright pkd.	1/ a 1/2
Amboyna ,,	Dull to fine	10d a 10½d
Zanzibar ,,	Fair and fine bright	5⅝d a 6¼d
Madagascar ,,	Fair	7d
Stems ,,	Fair	2d
COFFEE		
Ceylon Plantation cwt.	Medium to bold	Nominal
Liberian ,,	Fair to bold	63/ a 80/
COCOA, Ceylon Plant. ,,	Special Marks	81/ a 88/6
	Red to good	73/ a 80/6
Native Estate ,,	Ordinary to red	42/ a 68/
Java and Celebes ,,	Small to good red	30s a 93s
COLOMBO ROOT ,,	Middling to good	15/ a 22/6
CROTON SEEDS, sifted,,	Dull to fair	42/6 a 47/6
CUBEBS ,, ,,	Ord. stalky to good	130/ a 150/
GINGER, Bengal, rough ,,	Fair	19/
Calicut, Cut A ,,	Medium to fine bold	75/ a 85/
B & C ,,	Small and medium	35/ a 74/
Cochin, Rough ,,	Common to fine bold	22/6 a 27/
	Small and D's	20/
Japan ,,	Unsplit	20/
GUM AMMONIACUM ,,	Ord. Blocky to fair clean	40/s a 72s 6d
ANIMI, Zanzibar	Pale and amber, str. srts	£14 10/a £16 10/
,,	,, ,, little red	£11 a £12
,,	Bean and Pea size ditto	70/ a £11
,,	Fair to good red sorts	£8 10/ a £10 10
,,	Med. and bold glassy sorts	£5 10/ a £7 5/
Madagascar ,,	Fair to good palish	£4 a £8
,,	,, ,, red	£4 a £7
ARABIC, E. I. & Aden ,,	Ordinary to good pale	26/ a 32/6
Turkey sorts ,,	,, ,,	37/ a 57/6
Ghatti ,,	Sorts to fine pale	17/ a 27/
Kurrachee ,,	Reddish to good pale	22/6 a 32/6 nom.
Madras ,,	Dark to fine pale	20/ a 30/ nom
ASSAFŒTIDA ,,	Clean fr. to gd. almonds	£6 a £6 10/
	com. stony to good block	40s a £5
KINO lb.	Fair to fine bright	6d a 1/5
MYRRH, Aden sorts cwt.	Middling to good	57/6 a 67/6
Somali ,,	,, ,,	52s 6d a 55s
OLIBANUM, drop ,,	Good to fine white	45s a 50s
,,	Middling to fair	35s a 40s
pickings ,,	Low to good pale	15/ a 27/6
siftings ,,	Slightly foul to fine	18s a 25s
INDIA RUBBER lb.	Fine Para smoked sheets	2/4
	Crepe ordinary to fine	2/2½
Ceylon, Straits, ,,	Fine Block	2/4¼
Malay Straits, etc. ,,	Scrap fair to fine	1/8 a 1/9
Assam ,,	Plantation	1/10
,,	Fair 11 to ord. red No. 1.	1/3 a 1/6
Rangoon ,,	,, ,, ,,	1/2 a 1/4

	QUALITY.	QUOTATIONS.
INDIA RUBBER lb.		
Borneo ,,	Common to good	9d a 1/3
Java ,,	Good to fine red	1/3 a 1/6
Penang ,,	Low white to prime red	9 d a 1/4
Mozambique ,,	Fair to fine red ball	1/9 a 2/1
,,	Sausage, fair to good	1/9 a 2
Nyassaland ,,	Fair to fine ball	1/9 a 2
Madagascar ,,	Fr. to fine pinky & white	1/4 a 1/6
,,	Majunga & blk coated	1/ a 1/2
,,	Niggers, low to good	6d a 1/6
New Guinea ,,	Ordinary to fine ball	1/4 a 1/7
INDIGO, E.I. Bengal ,,	Shipping mid to gd. violet	3s 3d a 3s 8d
,,	Consuming mid. to gd.	2s 9d a 3s 2d
	Ordinary to middling	2s 4d a 2s 9d
,,	Mid. to good Kurpah	1s 11d a 2s 5d
,,	Low to ordinary	1s 6d a 1s 9d
,,	Mid. to fine Madras	1/11 a 2/9
MACE, Bombay & Penang	Pale reddish to fine	2/4 a 2/6
per lb.	Ordinary to fair	2/ a 2/2
Java ,,	,, good pale	2/ 1 a 2/4
Bombay	Wild	1/
NUTMEGS,— lb.		
Singapore & Penang ,,	64's to 57's	9½d a 10½d
	80's	7⅝d
	110's	6½d
NUTS, ARECA cwt.	Ordinary to fair fresh	17/6 a 20/
NUX VOMICA, Cochin	Ordinary to good	13/6 a 15
per cwt. Bengal	,, ,,	12/
Madras	,, ,,	12/ a 13/
OIL OF ANISEED lb.	Fair merchantable	5/2
CASSIA ,,	According to analysis	2/8 a 2/11
LEMONGRASS oz.	Good flavour & colour	2½d
NUTMEG ,,	Dingy to white	1½d a 1⅝d
CINNAMON ,,	Ordinary to fair sweet	4d a 1s 5d
CITRONELLE lb.	Bright & good flavour	1/6½
ORCHELLA WEED—cwt		
Ceylon ,,	Fair	10/6
Madagascar ,,	Fair	10/6
Zanzibar ,,	Fair	10/6
PEPPER—(Black) lb.		
Alleppy & Tellicherry	Fair	5d
Ceylon ,, ,,	Fair to fine bold heavy	5d a 5⅜d
Singapore ...	Fair	4⅝d
Acheen & W. C. Penang	Dull to fine	5d a 5½d
(White) Singapore ,,	Fair to fine	8½d a 8⅝d
Siam ,,	Fair	8½d
Penang ,,	Fair	7⅜d
Muntok ,,	Fair	9d
RHUBARB, Shenzi ,,	Ordinary to good	2/ a 4/
Canton ,,	Ordinary to good	1/10 a 3/6
High Dried,,	Fair to fine flat	11d a 1/1
	Dark to fair round	9 d a 10d
SAGO, PEARL, large--cwt	Fair to fine	18/
medium ...	,, ,,	16/
small ...	,, ,,	13/ a 14/
Flour ...	Good pinky to white	10/ a 11
SEEDLAC cwt.	Ordinary to gd. soluble	65/ a 75/
SENNA, Tinnevelly lb.	Good to fine bold green	5d a 8½d
	Fair greenish	3d a 4½d
	Common specky & small	1½ d a 2½d
SHELLS, M. o' PEARL—		
Egyptian cwt.	Small to bold	72/6 a £6
Bombay ,,	,, ,,	85/ a £6 10/
Mergui ,,	Chicken to bold	£8 12/6 a £145
Manilla ,,	Fair to good	£7 17/6a 13 10
Banda ,,	Sorts	50/ nom.
Green Snail ,,	Small to large	70/ a 85/
Japan Ear ,,	Trimmed selected small	
	to bold	47/ a £5 15
TAMARINDS, Calcutta...	Mid to fine bl'k not stony	14/ a 15/
per cwt. Madras	Inferior to good	6/ a 10.
TORTOISESHELL—		
Zanzibar & Bombay lb.	Small to bold	12/ a 26/
	Pickings	6/6 a 19/
TURMERIC, Bengal cwt.	Fair	12/ a 13/
Madras ,,	Finger fair to fine bold	14/ a 16/
Do. ,,	Bulbs ,, ,, [bright	12/ a 13/
Cochin ,,	Finger fair	13/ nom.
	Bulbs ,,	11/6 a 12/
VANILLOES— lb.		
Mauritius ... } 1sts.	Gd. crystallized 3½a 8½ in.	9/6 a 15/
Madagascar ... } 2nds.	Foxy & reddish 3½a ,,	9/ a 12/
Seychelles ... } 3rds.	Lean and inferior	9/ a 9/6
VERMILLION ... lbs.	Fine, pure, bright	2/7
WAX, Japan, squares cwt.	Good white hard	47/6